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Portable Four Channel Oscilloscope

PM3244

9499 440 17002

770425/03/04/05

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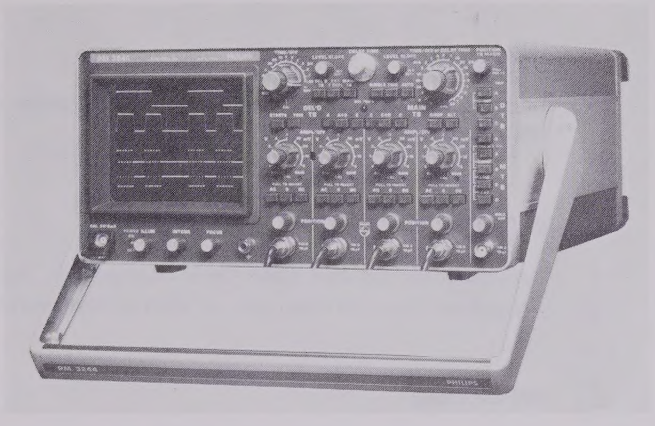

Instruction manual
Gerätehandbuch
Notice d'emploi et d'entretien

Portable Four Channel Oscilloscope
Tragbarer Vierkanal Oszillograf
Oscilloscope portatif à quatre voies

PM 3244

This insert must be used
with the manual of the
basic PM 3240 oscilloscope.

Order no. of
this insert
9499 440 15511

9499 440 17002

770425/03/04/05

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type at le numéro de série sont marqués sur la plaquette de caractéristiques.

NOTE: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

REMARQUES: *Cet appareil est l'objet de développements et amélorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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Instruction manual

1.General information

1.1. Introduction

The PM 3244 portable h.f. oscilloscope features four identical vertical deflection channels with high sensitivity (5 mV/div.) over a large bandwidth of 50 MHz.

There is a wide choice of vertical deflection possibilities, such as one, two, three or four channels (alternately or chopped) Also adding of the first two channels and of the last two channels is possible.
The polarity of each channel can be inverted.

Horizontal deflection possibilities are: main time base (with or without intensified delay time base), delayed time base, or external deflection.

Except the normal trigger source choice the PM 3244 also features composite triggering.

This oscilloscope has a low dissipation tapless power supply, working on any a.c. line voltage between 90 V and 270 V, or any d.c. voltage between 100 V and 350 V.

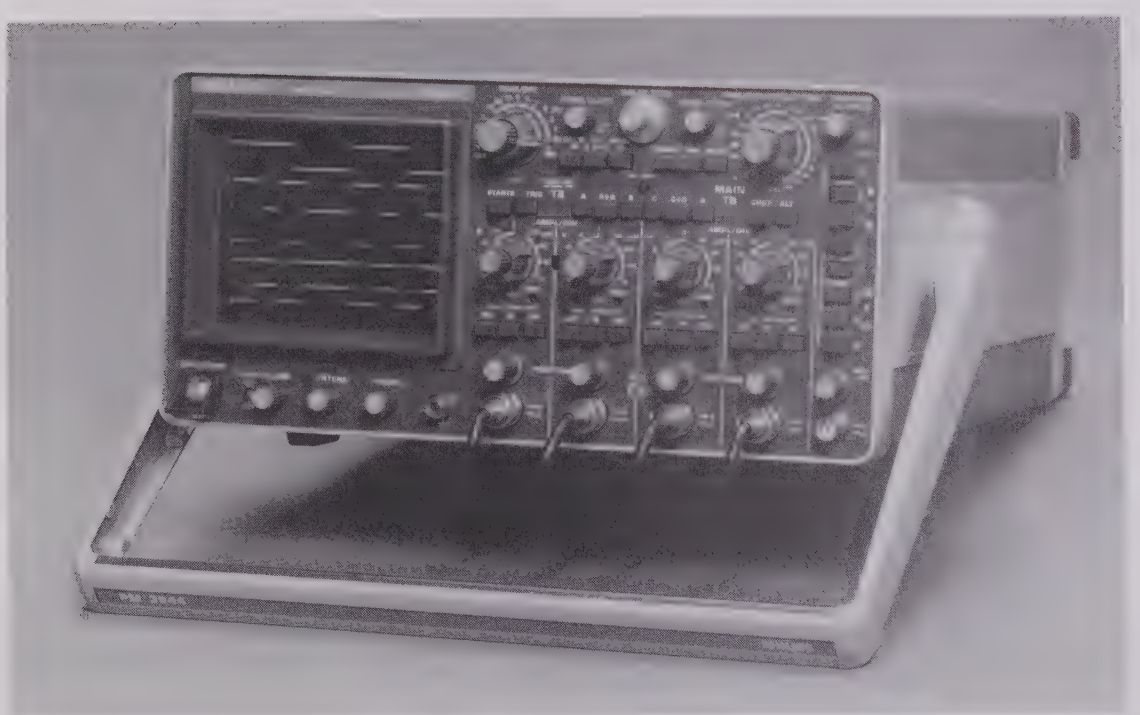


Fig. 1.1. Portable four channel H.F. oscilloscope PM 3244

1.2. CHARACTERISTICS

This specification is valid after the instrument has warmed up for 15 minutes.
Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer.
Numerical values without tolerances are typical and represent the characteristics of an average instrument.

This instrument has been designed and tested in accordance with IEC Publication 348 for Class I instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

	Designation	*Specification*	*Additional Information*
1.2.1.	**C.R.T.**		
	Type	D14-125 GH/08	Rectangular tube face, mesh type, post accelerator, metal backed phosphor.
	Measuring area	80 mm x 100 mm	Divided in 8x10 divisions.
	Screen phosphor	P31 (GH)	P11 (BE) and P7 (GM) phosphor optional.
	Photographic writing speed	$\geqslant$ 750 cm/μs	Measured with Steinheil Oscillophot M5 camera Aperture 1:1,2 Object to image ratio 1:0,5 Film: Polaroid 410 (10000 ASA) No pre-fogging Phosphor P31 (GH)
	Total acceleration voltage	10 kV	
	Graticule	8x10 cm divisions with sub-divisions of 2 mm along the central axes.	Dotted lines indicate 10 % and 90 % of measuring lattice for rise-time measurements.
	Graticule illumination	Continuous variable	Maximum brightness clearly visible under normal lab. type light conditions.
1.2.2.	**Vertical deflection (Y)**		
	Number of channels	4	Four identical channels, marked A, B, C en D
	Display modes	Channel A only Channel B only Channel C only Channel D only Channels A+B added Channels C+D added either of these modes in any combination, chopped or alternatively displayed. All channels can be inverted.	
	Display time per channel in chopped mode	Approx. 0.5 μs	From /03 version: switchable between 0.5 μs and 2 μs (see Fig. 3.18).
	Frequency range	d.c. ... 50 MHz	d.c. coupled Upper bandwidth limit –3 dB
		10 Hz ... 50 MHz	a.c. coupled –3 dB bandwidth limit
	Rise time	7 ns	
	Aberrations	± 2 % max.	Measured with test pulse of 6 div. deflection / 1 ns rise time and 1 μs repetition time.

Designation	*Specification*	*Additional Information*
Deflection coefficients	5 mV/DIV ... 2 V/DIV	Nine calibrated positions in 1-2-5 sequence. Uncalibrated, continuous control 1 : ⩾ 2,5.
Accuracy	± 3 %	
Input voltage	± 400 V max.	d.c. + a.c. peak In the 5 mV/DIV ... 20 mV/DIV positions of the input attenuator derating at frequencies over 500 kHz. Refer to Fig. 1.2.
Max. deflection	24 div. ⩾ 6 div.	For sine waves up to 15 MHz. For sine waves from 15 MHz up to 50 MHz.
Max. total signal amplitude in A-B and C-D modes	24 x attenuator-setting	Attenuators in CAL. positions.
Positioning range	16 div.	
Common-mode rejection	⩾ 100:1 at 1 MHz	After adjusting
Cross talk between channels	35 dB max.	For all attenuator combinations. Reference is 6 div. signal amplitude (0 ... 50 MHz) Chopped mode.
Trace stability D.C. drift	⩽ 0,3 div/h at 20 °C	After 15 min. warm-up
Temp. drift	⩽ 60 μV/°C typical	
Attenuator balance	⩽ 0,3 div.	When switching between any of the attenuator positions.
Input		
Impedance	1 Mohm//15 pF	
Coupling	AC-0-DC	
RC time	22 ms	Coupling switch in AC position.
Visible signal delay	20 ns	

1.2.3. Horizontal deflection (X)

Display modes	– Main time base – Main time base intensified by delayed time base – Delayed time base – X/Y mode	Up to four trace X/Y operation with X deflection by one of the four vertical channels, or an external signal, or the line signal.

Horizontal deflection amplifier

Bandwidth	d.c. ... 1 MHz	over 6 div's – 3 dB upper bandwidth limit
Deflection coefficient	450 mV/div Vertical attenuator coefficients	using EXT input apply when one of the vertical channels is used for horizontal deflection
Accuracy	± 10 %	Using one of the vertical channels for horizontal deflection.
Input impedance	1 Mohm//15 pF	
Phase difference between Vert. and Hor. defl. amplifier	less than 3°	at 100 kHz

	Designation	*Specification*	*Additional Information*
	Deflection by line voltage	8 div's	The deflection depends on the line voltage and has been factory-adjusted to 8 DIV at a line voltage of 220 V.
1.2.4.	**Main time base**		
	Operation	Automatic Triggered Single shot	In the AUTO mode the time base is free-running approx. 100 ms. after disappearance of the trigger signal.
	Time coefficients	0,5 s/DIV ... 50 ms/DIV	Twenty-two calibrated positions in 1-2-5 sequence. Uncalibrated, continuous control 1 : ⩾ 2,5
	Accuracy	± 3 %	± 5 % for 0.5 s/DIV and 0.2 s/DIV ± 5 % for 100 ns/DIV and 50 ms/DIV
1.2.5.	**Delayed time base**	Direct running after delay time or triggerable after delay time	
	Time coefficients	1 ms./DIV ... 50 ns./DIV	Fourteen calibrated positions in 1-2-5 sequence. Uncalibrated, continuous control 1 : ⩾ 2,5
	Accuracy	± 3 %	± 5 % for 100 ns./DIV and 50 ns./DIV
	Time Base Magnifier		
	Magnification	x5	
	Highest effective sweep speed	10 ns./div.	
	Additional tolerance	± 2 %	
1.2.6.	**Triggering of M.T.B.**		
	Source	Internal Composite Line External	From ch. A, B, C or D
	Trigger bandwidth	d.c. ... 50 MHz	Upper bandwidth limit −15 dB
	Trigger sensitivity	Internal ⩽ 0,5 div. External ⩽ 250 mV	0,3 div. typical 150 mV typical
	Slope selection	+ or −	
	Ext. trigger input impedance	1 Mohm//15 pF	Identical to any vertical deflection input
	Input voltage	± 400 V max.	d.c. + a.c. peak
1.2.7.	**Triggering of D.T.B.**		
	Identical to main time base triggering except:		
	Source	Internal Composite	From ch. A, B, C or D
	Sweep delay		
	Delay time	Continuously variable between 0.3x and ⩾ 10x the time-coefficient of the main time base.	Adjustable with calibrated ten turn dial knob.
	Incremental delay time error	0,5 %	
	Delay time jitter	⩽ 1 : 20 000	

	Designation	*Specification*	*Additional Information*
1.2.8.	**Calibration unit**		
	Voltage	3 V_{p-p}	Square wave, base-line zero volts
	Current	6 mA	Through current loop
	Accuracy	± 1 %	For both voltage and current
	Frequency	2 kHz ± 2 %	
	Protection	The output is short-circuit-proof	
1.2.9.	**Power supply**		
	Line voltages	90 ... 270 V AC or 100 ... 350 V DC	In one range
	Line frequency	46 ... 440 Hz or DC	
	Build-in line fuse	1,6 amp. delayed-action	For all line voltages
	Power consumption	29 W	

1.2.10. **Environmental characteristics**

The environmental data are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, HOLLAND.

Ambient temperature	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Rated range of use Limit range of operation Storage and transport
Altitude	5000 m (15000') 15000 m (45000')	Operating Non operating
Humidity	The instrument meets the requirements of the IEC 68 Db recommendations.	
Bump	1000 bumps of 10 g, ½ sine, 6 ms duration, in each of 3 directions	
Vibration	30 minutes in each of three directions, 10-150 Hz; 0,7 mm p-p and 5 g max. acceleration	
Recovery time	30 minutes for normal operation	Coming from −10 °C and going to +20 °C at 60 % relative humidity.
Electromagnetic interference	The instrument meets the VDE, Störgrad K, requirements.	

1.2.11.	**Mechanical data**		
	Dimensions	Length 410 mm (16 1/4") Width 316 mm (12 1/4") Height 154 mm (6 1/8")	Excl. controls, cover and feet
	Weight	9,7 kg	

1.2.12. **Delivered accessories**

Contrast filter
Front cover
Collapsible viewing hood PM 9366
BNC-banana adaptor PM 9051
Cal. terminal to BNC adaptor
Operating and service manual
4x 10 : 1 probe PM 9350/PM 8927

1.2.13. Optional accessories

PM 9335	Passive probe set 1 : 1 (1.5 m)
PM 9335L	Passive probe set 1 : 1 (2.5 m)
PM 9350	Passive probe set 10 : 1 11 pF (1.5 m)
PM 9350L	Passive probe set 10 : 1 14 pF (2.5 m)
PM 8927	Passive probe set 10 : 1 (1.5 m)
PM 8927L	Passive probe set 10 : 1 (2.5 m)
PM 9358	Passive probe set 100 : 1; max. voltage 5600 V; 2 pF (1.5 m)
PM 9347	Active TV triggering probe 10 : 1 11 pF (1.5 m)
PM 9352	Micro miniature probe 10 : 1 6 pF (2.5 m)
PM 9353	Active FET probe 1 : 1; 10 : 1; 100 : 1, 3.5 pF (1.5 m)
PM 9355	Current probe; 1 mA/div. ... 1 A/div.; 12 Hz ... 70 MHz
PM 9346	Power supply for active probes
PM 8960	19 inch rack mount adaptor
PM 8992	Accessory pouch
PM 9380	Oscilloscope camera
PM 8971	Adapter for oscilloscope camera
PM 8910	Polaroid anti-glare filter
PM 8980	Long type viewing hood
PM 8901	Battery pack 24 V dc and 140 V dc
PM 8991	Oscilloscope trolley

Steinheil Oscillophot system: Oscilloscope camera's M3, M4 and M5 can be mounted on oscilloscope using Steinheil adapter 1820/50.

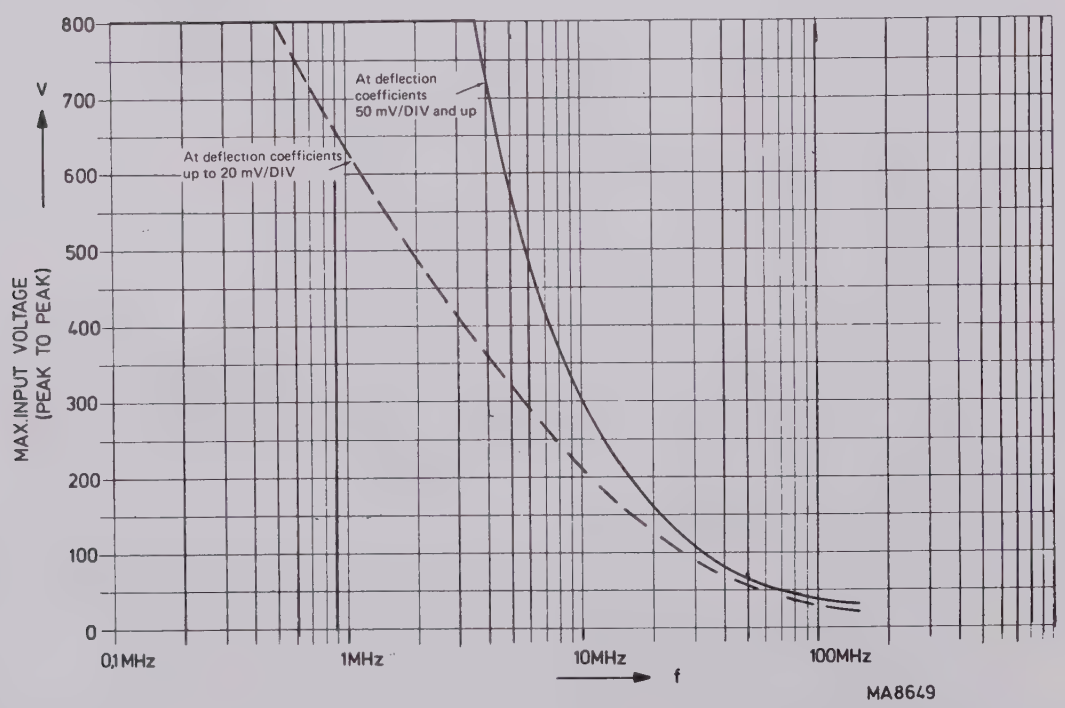


Fig. 1.2. Derating of the maximum permissible input voltage as a function of frequency

Fig. 2.1. Removing the front cover.

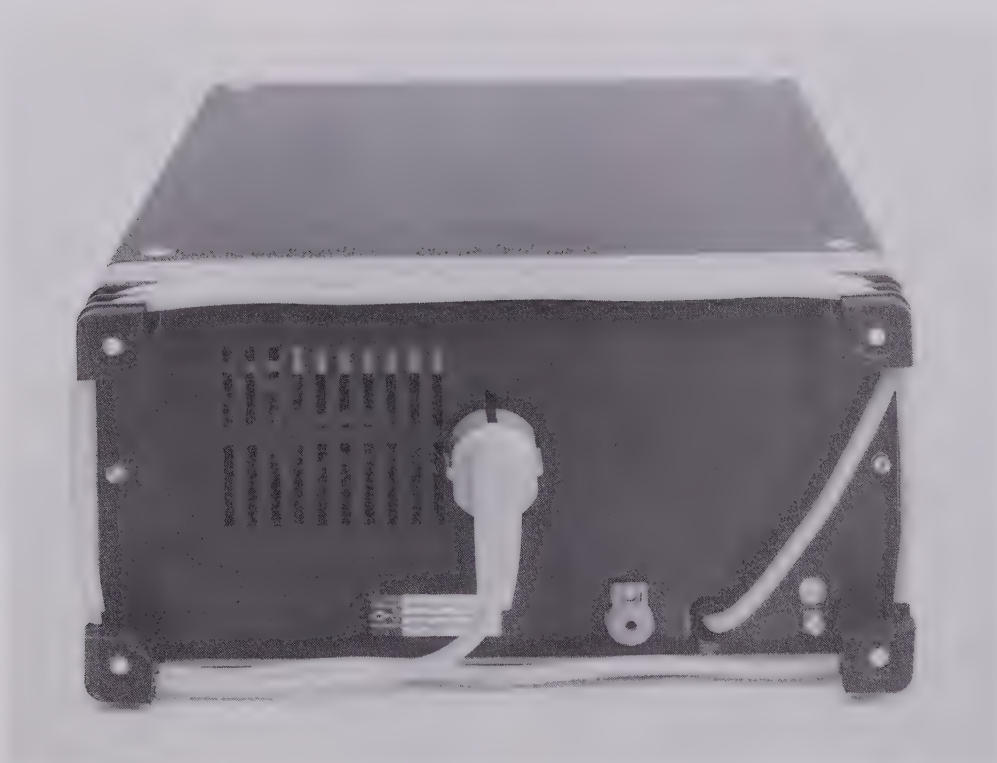


Fig. 2.2. Rear view of the instrument.

2. Directions for use

2.1. INSTALLATION

2.1.1. Removing and fitting the front cover

Removing:
- Turn the knob in the centre of the cover a quarter of a turn anti-clockwise.
- Take the cover off.

Fitting:
- Align the key of the locking knob with the slot in the text plate of the instrument.
- Fit the cover over the front of the oscilloscope.
- Press the knob and turn it a quarter of a turn clockwise.

Remark: The handle can be rotated if the push-buttons on its bearings are depressed.

WARNING: This instrument generates high voltages and should not be operated with the cabinet plates removed. The line plug must be removed before attempting any maintenance work, and any relevant high-voltage points discharged.
Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section *earthing).*

2.1.2. Mains adaption and fuse

The ability of the instrument to operate at any line voltage between 90 and 270 V a.c. or between 100 and 350 V d.c. obviates the need of adaption to the local line voltage.
The fuse holder is mounted on the rear panel. The 1,6 A delayed action fuse is used at all line voltages.
Make sure that only fuses with the required rated current and of the specified type are used for replacement.
The use of mended fuses and the short-circuiting of fuse holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced.

2.1.3. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:
- Via the protective earth terminal (identified by the symbol ⏚).
- Via the three-core line cable. The line plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

When an instrument is brought from a cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.

2.1.4. Dismantling

The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and also accessible terminals may be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.

If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the danger involved.

Replacing the mains plug is at the user's own risk. After replacing a mains plug, a high-voltage test in accordance with IEC Publication 348 is strongly recommended.

Bear in mind that capacitors inside the instrument may still be charged, even if the instrument has been separated from all voltage sources.

2.1.5. Switching on

The POWER switch is incorporated in the graticule ILLUMination control on the front panel, immediately below the screen bezel. The oscilloscope must never be switched on whilst any circuit board has been removed. Never remove a circuit board until at least one minute after the oscilloscope has been switched off.

2.2. FUNCTION OF CONTROLS AND INPUT SOCKETS

2.2.1. Vertical deflection

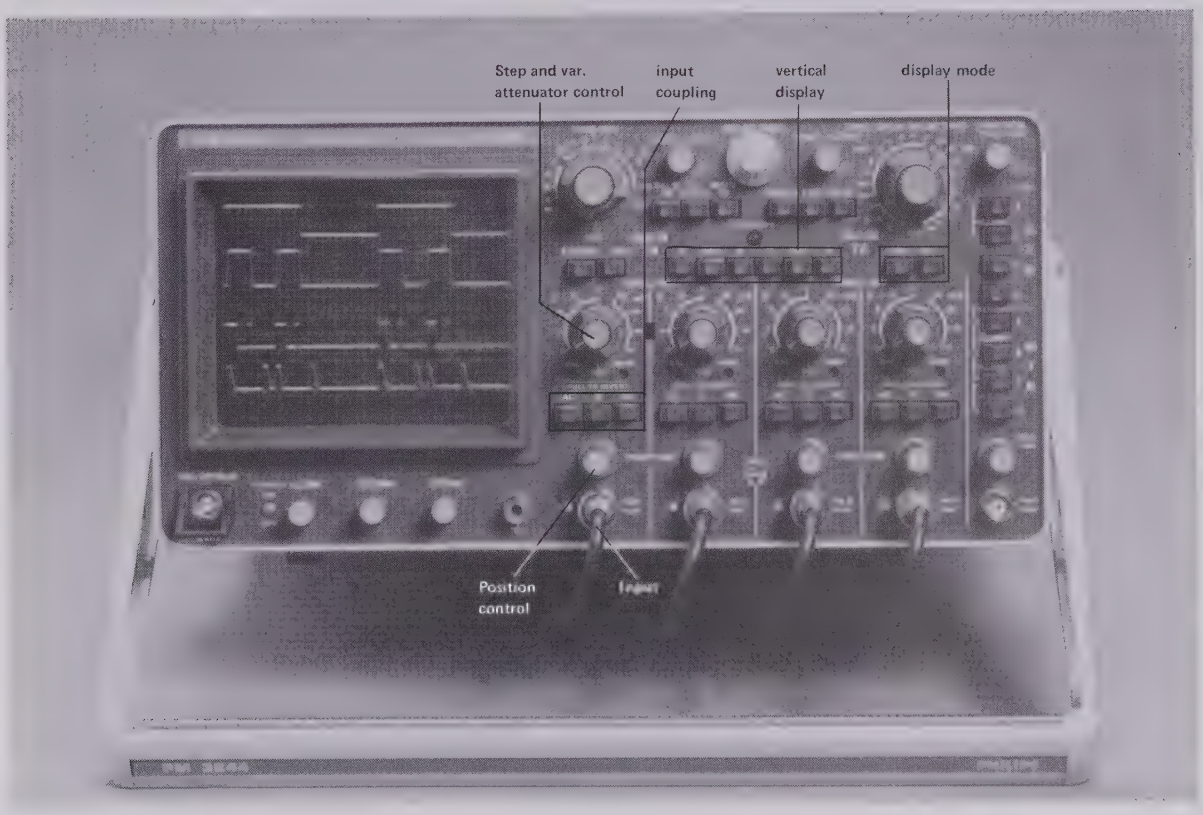


Fig. 2.3. Vertical deflection

1. Vertical deflection mode switch.

Button A	channel A
Button A+B	channels A and B algebraically added
Button B	channel B
Button C	channel C
Button C+D	channels C and D algebraically added
Button D	channel D

Any combination of above displays is possible (if no button depressed, channel A is on).

2. CHOP-ALT switch

The under point 1 mentioned channel displays, can be in the chopped- or the alternated mode, depending of this switch (if no button depressed and two or more channels are on, the display is in the chopped mode).

3. Attenuator controls

AMPL/DIV	Step control of the deflection coefficients combined with:
AMPL/CAL	Continuously variable control of the deflection coefficients. If this knob is pulled-out the channel polarity is inverted.
Input coupling switch	AC Signal coupling via a blocking capacitor. 0 Channel input connected to earth; signal-load open. DC Direct coupling. (If no button is depressed, the AC situation is on).
POSITION	Continuously variable control giving vertical shift of the relevant channel.
PRE-SET CONTROLS:	
BAL	Step attenuator balance
GAIN	Step attenuator amplitude calibration.

2.2.2. Horizontal deflection

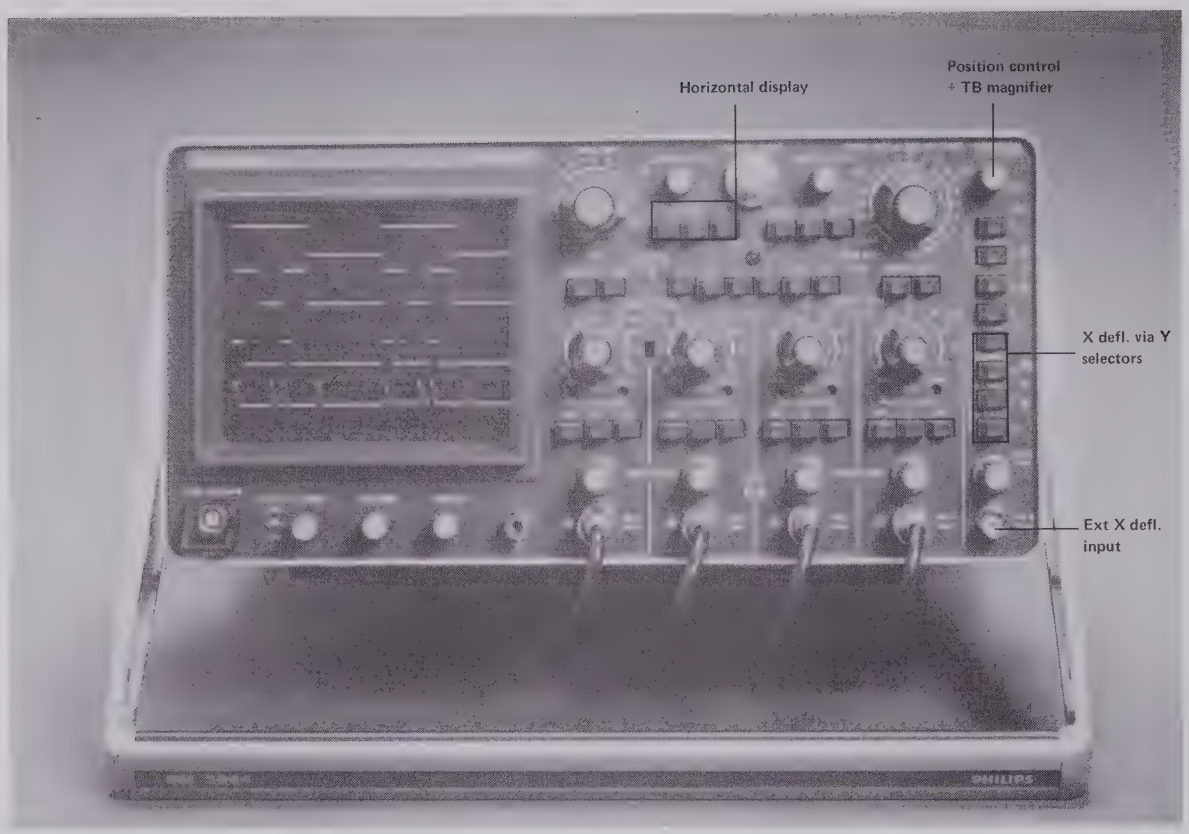


Fig. 2.4. Horizontal deflection.

1. Horizontal deflection mode switch.

MAIN TB	The horizontal deflection is provided by the main time base generator. A part of the display is intensified when the delayed time base is on.
EXT X DEFL	Horizontal deflection is achieved by an external signal coming from: – Input socket of the horizontal amplifier, or – One of the vertical deflection channels or – The line.
DEL'D TB	The horizontal deflection is provided by the delayed time base generator (if no button is depressed, the main tb is on).

2. Position and TB magnifier

POSITION	Continuously variable control giving horizontal shift of the display.
TB MAGN	Push-pull switch which increases the time-base coefficients by a factor of 5. Not operative in the EXT X DEFL. mode.

2.2.3. Main time base

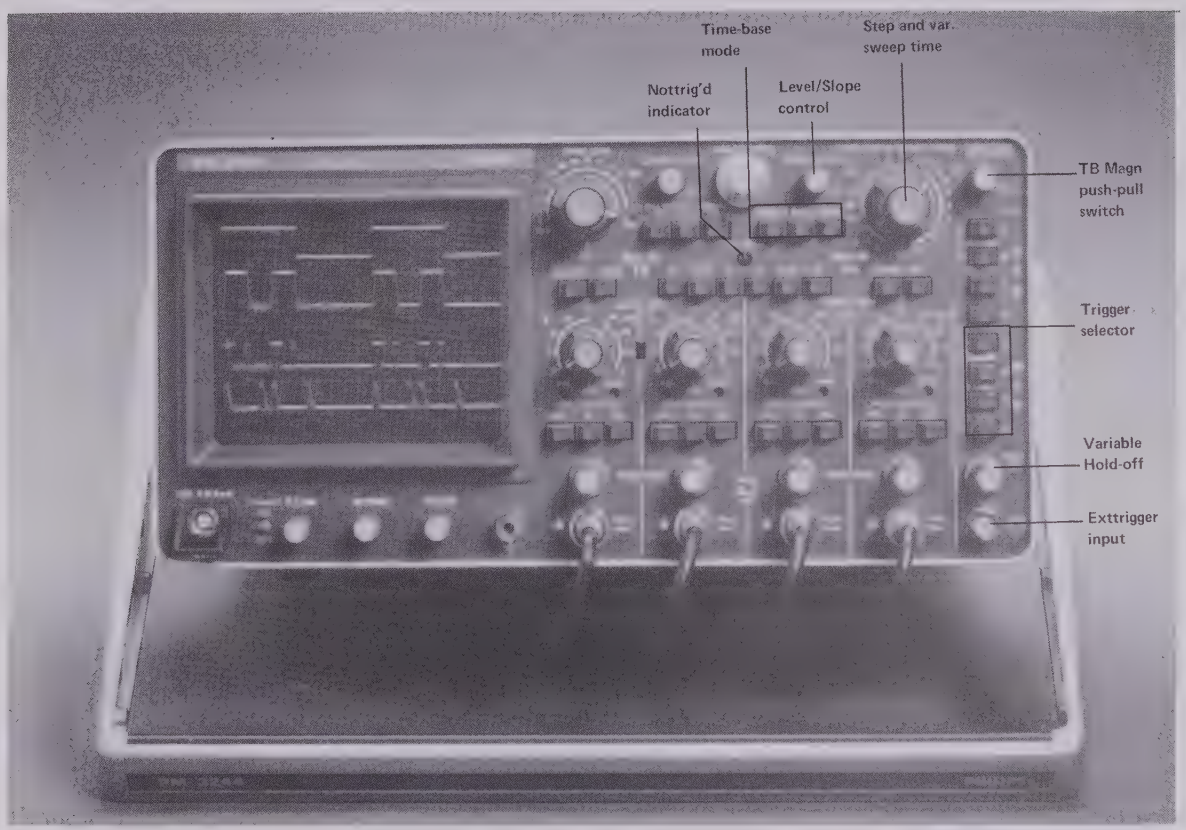


Fig. 2.5. Main time base

1. Main time-base mode switch	
AUTO	The main time-base generator is free-running when no trigger pulses are present.
TRIG	The main time-base is normally triggered.
SINGLE	Single sweep time-base. After operating the SINGLE button, the main time-base generator runs only once upon receipt of a trigger pulse. (If no button is depressed the time-base is in the single sweep mode.)
2. TIME/DIV or DELAY switch	Step control of the main time-base time coefficients: 22-way rotary switch. If the delayed time-base is operating, the delay time after which the delayed time-base starts, is the product of the DELAY TIME calibrated dial setting and the TIME/DIV coefficient of this switch.
TIME/DIV CAL	Continuously variable control of the time coefficients.
3. LEVEL/SLOPE	Continuously variable control to select the trigger level at which the time-base generator starts. The push-pull switch enables choice of triggering on the positive- or negative-going slope of the singal.
4. NOT TRIG'D indicator	Lights up when the main time-base generator is not triggered.
5. MTB Trigger source selector switch	This switch consists of four buttons (A, B, C and D) to select the trigger signal from one of the vertical deflection channels. When both buttons A and B are depressed, the composite trigger signal is selected. When both buttons B and C are depressed, part of the line voltage is used as a trigger signal. When both buttons C and D are depressed, the signal applied to the EXT connector is used as a trigger signal. (If no button is depressed, the A trigger signal is on.)

2.2.4. Delayed time base

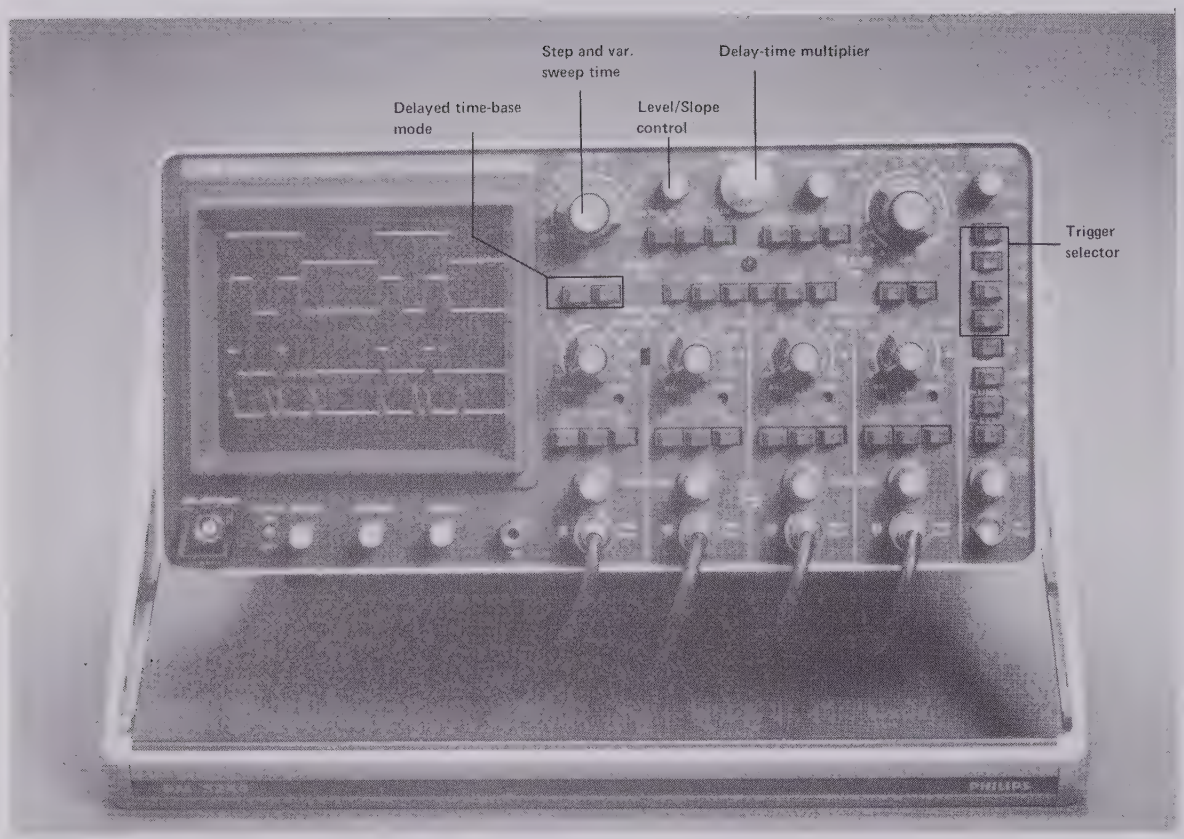


Fig. 2.6. Delayed time base.

1. TIME/DIV switch	Step control of the delayed time-base time coefficients; 14-way rotary switch. In the OFF position the delayed time-base is not operating.
TIME/DIV CAL	Continuously variable control of the time-base coefficients.
2. DELAY TIME	Calibrated ten-turn dial knob to adjust the delay time after which the delayed time base becomes operative. This delay time is the product of the DELAY TIME dial setting and the TIME/DIV coefficient switch of the main time-base.
3. STARTS/TRIG	If the STARTS button has been depressed, the delayed time-base starts immediately after the delay-time (the delayed time-base requires then no trigger signal). If the TRIG. button has been depressed the delayed time-base starts after the delay-time upon receipt of a trigger pulse. (No button depressed has the same effect as the STARTS button depressed.)
4. LEVEL/SLOPE	Continuously variable control to select the trigger level at which the delayed time-base generator triggers. The push-pull switch enables choice of triggering on the positive- or negative-going slope of the signal.
5. DTB Trigger source selector switch	This switch consists of four buttons (A, B, C and D) to select the trigger signal from one of the vertical deflection channels. When both buttons A and B are depressed, the composite trigger signal is selected. (If no button depressed, the A trigger signal is on).

2.2.5. C.R.T. display section

1. POWER/ILLUM	Continuously variable control of the graticule illumination combined with power on-off switch. Pilot lamp indicates the ON state.
2. INTENS	Continuously variable control of the display-brightness.
3. FOCUS	Continuously variable control of the electron-beam focussing.

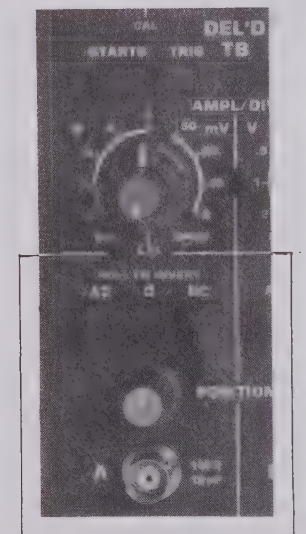
Miscellaneous

1. CAL	Output socket for calibration of: – The gain of the vertical deflection amplifier and, – The frequency compensation of attenuator probes. Suited for voltage probes and current probes.

2.3. PRELIMINARY SETTINGS

Before measurements with this oscilloscope are carried out, check that the step-attenuator balance and the gain calibration for all channels are well adjusted.
If necessary proceed as follows:

1. Adjusting the step attenuator d.c. balance
   - Depress the MAIN TB button of the horizontal deflection mode switch.
   - Depress the AUTO button of the main time-base mode switch.
   - Set the INTENSITY and FOCUS controls for a sharp, well-defined trace.
   - Depress the relevant channel button of the vertical deflection mode switch.
   - Depress the 0 button of the input coupling switch.
   - Set the POSITION knob so that the trace is somewhere about in the centre of the screen.
   - Set the AMPL continuous control to position CAL.
   - Check that the trace does not jump when the AMPL switch knob is rotated.
     If necessary, adjust the BAL control.
   - Repeat for each channel.
2. Gain calibrations
   Unless otherwise stated, the controls occupy the same positions as in the previous procedure.
   - Set the AC-0-DC switch to AC.
   - Set the AMPL switch knob to .5 V and the continuous control to CAL.
   - Connect the channel input to the CAL output.
   - Check the vertical deflection is exactly 6 divisions.
     If necessary adjust the GAIN control.
   - Also an attenuator probe can be included in this calibration. The probe attenuation factor must then be taken into account with respect to the AMPL switch position.
   - Repeat for each channel.



Att. step balance Gain calibration

2.4. OPERATING INSTRUCTIONS

2.4.1. General

Before switching-on, ensure that the oscilloscope has been correctly installed in accordance to the INSTALLATION RECOMMENDATIONS (Chapter 2.1.) and the precautions outlined have been observed.

2.4.2. Vertical deflection

To display the desired channels depress the corresponding buttons of the vertical deflection mode switch. If two or more traces are displayed, the display can be in the alternate- or the chopped mode.
In the alterate mode the channels are displayed successively; during fly-back of the main time-base sweep the display is switched-over from one channel to another.
In the chopped mode the channels are switched-over from one to another during the time-base sweep. The display time in the chopped mode is approx. 500 ns per channel. From /03 version switchable between 0.5 and 2 μs, see fig. 3.18).
To obtain a steady display generally the alternate mode is used at the higher sweep speeds and the chopped mode at the lower sweep speeds.

Note that in the composite trigger mode, the alternate display mode must be chosen, otherwise the chopper pulses will influence the trigger circuit.
The signals under observation are fed to input socket(s) A ... D and the AC/0/DC switch is set to either AC or DC, depending upon the composition of the signal. As the vertical amplifiers are d.c. coupled, the full bandwidth of the instrument is available and d.c. components are displayed as trace shift in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. component. Some pulse droop, however, will occur when l.f. square-wave signals are displayed.

The 0 position interrupts the signal-path and earths the amplifier-input for quickly determining the 0 V level. With the position controls the display can be shifted in vertical direction. Note that in the composite trigger mode the trigger start point also is influenced by the vertical position control.

2.4.3. Horizontal deflection

Depending on the position of the horizontal display switch the horizontal deflection can be:
- Main time-base
- Ext. X defl.
- Delayed time-base.

With the position control, combined with time-base magnifier, the display can be shifted in horizontal direction.

If the MAIN TB or DEL'D TB button is depressed, the horizontal deflection is effected by the main time-base or the delayed time-base respectively. If the EXT X DEFL button is depressed the horizontal deflection can be taken from:
- One of the vertical deflection channels A, B, C or D
- Line voltage (mains)
- Externally via EXT connector

2.4.4. Main time base

Linear horizontal deflection is obtained when the MAIN TB button of the horizontal display switch is depressed.
The time-base mode can be chosen with the time-base mode switch:

AUTO — Time-base is running, also if no trigger pulses are present. The trace is, therefore, always visible. The AUTO mode can be used in all cases where also the TRIG mode is usable, except with signal frequencies lower than 10 Hz, or pulse trains with an off-time exceeding 100 ms. As soon as trigger pulses are present, the free-running state of the time-base is automatically terminated and the time-base generator is normally triggered.

TRIG — The time-base is visible when trigger pulses are present and trigger-level control is correct.

SINGLE — The time-base makes only one sweep after receipt of a trigger pulse. After this sweep the time-base must be reset by depressing the SINGLE button once again.
When effects which occur only once, have to be observed (usually photographed), it is often desirable to ensure that only one sweep is generated, even though several trigger pulses might be produced after the phenomenon of interest.

2.4.5. Triggering

If one or more signals must be displayed, the time-base sweep must always be started on one fixed point of the signal, in order to obtain a stationary display.
The time-base generator is, therefore, started by trigger pulses which are derived from the following signal sources, depending on the main time-base trigger selector switch:
- One of the vertical deflection channels A, B, C or D
- Composite signal
- Line voltage
- External voltage

The amplitudes of the trigger signals from one of the vertical deflection channels, or from the composite signal are proportional to the vertical deflection of the display, hence depending on the input attenuator settings.

For composite triggering buttons A and B must be depressed, in this mode the trigger signal is taken from the common vertical deflection amplifier. Composite signal triggering features:

a. Triggering by differential signals if e.g. the instrument is in the A+B mode, with one of the input voltages inversed.
b. Two up to four signals with different, non-related frequencies can be displayed.
   In this case the trigger points of the various signals must be in the same trigger level range.

Note: — *When triggering in the composite mode, the display must always be in the ALT mode. In the CHOP mode the chopper pulses will function as trigger pulses hence the display will be unstable.*
— *In the composite triggering mode the trigger point of the signal depends also on the vertical POSITION control. A small modification for "AC" composite triggering described in part 3.2.2. solves this problem.*

Line triggering is realised by depressing both buttons B and C.
The main time-base is triggered by part of the line voltage (mains). The coupling with the line voltage is obtained by a build-in opto-isolator circuit, hence the instrument remains isolated from the line voltage.

External triggering is realized by depressing both buttons C and D.
The main time-base is now triggered by an external signal applied via the EXT connector.

With the LEVEL control the point of triggering on the slope of the signal can be chosen.
The SLOPE push-pull switch permits selection of the positive- or negative going slope.

If the main time-base generator gets no trigger pulses the NOT TRIG'D indicator lights up.
In the SINGLE sweep mode this indicator lights up if the time-base generator has been reset and is waiting for the next trigger pulse.

The sweep time of the main time-base is set with the knob TIME/DIV or DELAY TIME. If the delayed time base is switched on, the time between starting of the main time-base and delayed time-base-sweep, is the product of the settings of the DELAY TIME 10-turn knob and the main time-base sweep time switch. With the centre knob time-base sweep times between the steps can be adjusted. For time-measurements this knob must always be in the CAL position.
The TIME/DIV coefficient of the time-base can be increased by a factor of 5, by pulling the TB MAGN push-pull knob.

With the HOLD OFF control, the hold-off time of the main time-base generator can be varied. This is the time the time-base generator needs to be ready for receipt of the next trigger pulse. The HOLD OFF control permits steady display of more complicated signals e.g. periodic double-pulses.
Fully clockwise is the normal position of the HOLD OFF control. Turning anti-clockwise the hold-off time is extended.

2.4.6. Delayed time base

If the MAIN TB button of the horizontal display switches is depressed, and the delayed time-base TIME/DIV knob is not in the OFF position, part of the main time-base sweep line is displayed at higher intensity.
The moment the delayed time-base is starting is determined by the settings of the main time-base TIME/DIV knob and the DELAY TIME 10-turn knob. If the STARTS button of the delayed time-base mode switch is depressed, the delayed time-base starts immediately after this delay time.
If the TRIG button is depressed the delayed time-base will start after this delay time and upon receipt of a trigger pulse.

The delayed time-base trigger selector has the same possibilities as the main time-base trigger selector except line and ext. triggering.
The LEVEL/SLOPE control function is the same as described for the main time-base.
The sweep time of the intensified part of the main time-base sweep depends on the setting of the delayed time-base TIME/DIV knob.
With the centre knob sweep times between the steps can be adjusted. For time measurements this knob must always be in the CAL position.

If the DEL'D TB button of the horizontal mode switch is depressed the intensified part of the main time-base sweep is displayed over the whole screen.

Gerätehandbuch

1. Allgemeines

1.1. EINLEITUNG

Der tragbare H.F. Oszillograf PM 3244 verfügt über vier identische Vertikalablenkungskanäle mit höchster Empfindlichkeit (5 mV/Teil) über eine grosse Bandbreite von 50 MHz.

Das Gerät bietet vielseitige Vertikalablenkmöglichkeiten, wie ein, zwei, drei und vier Kanäle (alternierend oder gechopped). Es gestattet auch Addition der ersten zwei und der letzten zwei Kanäle.
Die Polarität jedes Kanals kann invertiert werden.

Horizontalablenkmöglichkeiten sind: Hauptzeitbasisablenkung (mit oder ohne aufgehellter verzögerter Zeitbasis), verzögerte Zeitbasisablenkung oder externe Ablenkung.

Ausser der normalen Triggerquelle-Einstellung ermöglicht der PM 3244 auch zusammengesetzte Triggerung.

Der PM 3244 hat eine Speisung mit niedriger Verlustleistung die bei jeder beliebigen Wechselspannung zwischen 90 V und 270 V und bei jeder beliebigen Gleichspannung zwischen 100 V und 350 V betriebsfähig ist.

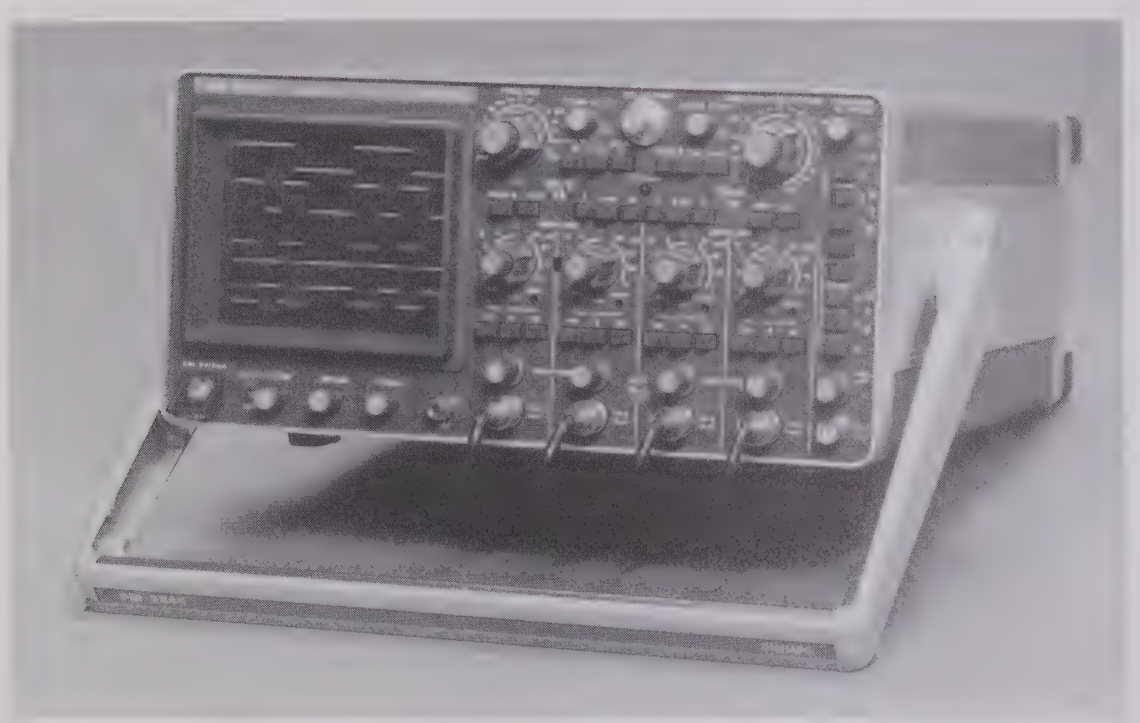


Abb. 1.1. Tragbarer Vierstrahl Hochfrequenz-Oszillograf PM 3244

1.2. TECHNISCHE DATEN

Dieses Gerät ist gemäss IEC 348, Sicherheitsbestimmungen für elektrische Mess- und Regeleinrichtungen, gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Anwender die Hinweise und Warnvermerke beachten, die in dem vorliegenden Gerätehandbuch enthalten sind.

Nur Angaben mit Toleranzen oder Grenzwerten können als garantierte Daten angesehen werden. Daten ohne Toleranzen, d.h. ohne Fehlergrenzen, sind informative Daten und werden nicht garantiert.
Fehlerangaben gelten nach einer Anwärmzeit von 15 Minuten nach dem Einschalten.
Prozentuale und absolute Fehler sind auf den jeweils angegebenen Referenzwert bezogen.

Benennung	*Beschreibung*	*Nähere Angaben*
1.2.1. Elektronenstrahlröhre		
Typ	PHILIPS D14-125 GH/08	Rechteckiger Schirm, mit Netzelektrode und Nachbeschleuniging, metallhinterlegter Leuchtschirm.
Ausnutzbare Schirmfläche	80 mm x 100 mm	
Schirmtyp	P31 (GH) Phosphor	P11 (BE) und P7 (GM) Phosphor auf Wunsch lieferbar.
Photografische Schreibgeschwindigkeit	> 750 cm/µs	Gemessen mit Steinheil Oscillophot M5 Kamera. Blende: 1:1,2 Bildausschnitt Verhältnis: 1:0,5 Film: Polaroid 410 (10000 ASA) Keine Vorbelichtung Phosphor Typ P31 (GH)
Gesamte Beschleunigungsspannung	10 kV	Gestrichelte linien
Raster	8 x 10 cm Teilung mit Untereinteilung von 2 mm an den mittleren Achsen	bei 10 % und 90 % des Messrasters, zur Messung von Anstiegzeiten.
Rasterbeleuchtung	Stetig regelbar	Max. Helligkeit bei normalen Laborbeleuchtungsbedingungen deutlich sichtbar.
1.2.2. Vertikalablenkung (Y)		
Anzahl Kanäle	4	Vier mit A, B, C und D bezeichnete Kanäle
Darstellungsarten	Kanal A allein Kanal B allein Kanal C allein Kanal D allein Kanäle A+B addiert Kanäle C+D addiert jede dieser Arten in beliebiger Kombination, gechopped oder alternierend dargestellt. Alle Kanäle können invertiert werden.	
Darstellungszeit pro Kanal in Chopper-Betrieb	ca. 500 ns.	Ab /03 Version: schaltbar zwischen 0,5 und 2 µs (siehe Fig. 3.18.)
Frequenzbereich	DC ... 50 MHz 10 Hz ... 50 MHz	Gleichspannungsgekoppelt Obere Bandbreitegrenze –3 dB Wechselspannungsgekoppelt –3 dB Bandbreitegrenze

Benennung	*Beschreibung*	*Nähere Angaben*
Anstiegzeit	7 ns	
Überschwingen	± 2 % maximal	Gemessen mit einem Prüfimpuls mit 6 Div. Auslenkung / 1 ns. Anstiegzeit und 1 µs Wiederholungszeit.
Ablenkkoeffizienten	5 mV/DIV ... 2 V/DIV	In neun kalibrierten Stufen in 1-2-5 Folge. Nichtkalibriert, kontinuierlich einstellbar 1 : ⩾ 2.5
Fehlergrenze	± 3 %	
Eingangsspannung	± 400 V maximal	Gleichspannung + Spitzenwert einer Wechselspannung. In den 5 mV/DIV ... 20 mV/DIV Stufen des Eingangsabschwächer, Minderung bei Frequenzen über 500 kHz. Siehe Abb. 1.2.
Maximale Ablenkung	24 DIV ⩾ 6 DIV	Für sinusförmige Signale bis 15 MHz Für sinusförmige Signale von 15 MHz bis 50 MHz
Maximale Gesamtsignal-amplitude in Betriebsarten A-B und C-D	24x Abschwächer Einstellung	Abschwächer in CAL Stellungen
Verschiebungsbereich	16 DIV	
Gleichtaktunterdrückung	⩾ 100:1 bei 1 MHz	Nach Abgleich
Übersprechen zwischen Kanälen	35 dB maximal	Für alle Abschwächerkombinationen Bezogen auf 6 DIV. Signalamplitude (0 ... 50 MHz) Chopper-Betrieb
Bild-Instabilität DC Drift	⩽ 0,3 DIV/Stunde bei 20 °C	Nach 15 Minuten Anwärmzeit
Temperaturdrift	⩽ 60 µV/°C typisch	
Abschwächungsgleichgewicht	⩽ 0,3 DIV	Beim Umschalten zwischen beliebigen Abschwächer-Einstellungen.
Eingangsimpedanz	1 Mohm//15 pF	
Kopplung	AC-0-DC	
RC-Zeit des Eingangs	22 ms	Kopplung-Schalter auf AC
Sichtbare Signalverzögerung	20 ns	

1.2.3. **Horizontalablenkung (X)**

Darstellungsarten	– Hauptzeitbasis – Hauptzeitbasis aufgehellt durch verzögerte Zeitbasis – verzögerte Zeitbasis – X/Y Betrieb	Bis zu vier X/Y Darstellungen. Betrieb mit X-Ablenkung durch einen der vier Kanäle, ein externes Signal oder das Netzsignal
Frequenzbereich des Horizontal-ablenkungs-Verstärkers	DC ... 1 MHz	über 6 DIV –3 dB obere Bandbreitegrenze
Ablenkkoeffizient	450 mV/DIV Vertikalabschwächkoeffizienten	Bei Anwendung von Eingang EXT Zutreffend wenn einer der vertikalen Kanäle für Horizontalablenkung angewandt wird.
Fehlergrenze	± 10 %	Bei Anwendung eines der vertikalen Kanäle für Horizontalablenkung

Benennung	*Beschreibung*	*Nähere Angaben*
Eingangsimpedanz	1 Mohm//15 pF	
Phasendifferenz zwischen Vertikal- und Horizontalabl. Verstärker	weniger als 3^{o}	bei 100 kHz
Ablenkung durch Netzspannung	8 DIV	Die Ablenkung ist abhängig von der Netzspannung und ist ab Fabrik eingestellt auf 8 DIV bei 220 V Netzspannung.

1.2.4. Hauptzeitablenkung

Betrieb	Automatisch Getriggert Einmalig	Bei Betriebsart AUTO ist die Zeitbasis etwa 100 ms nach Verschwinden des Triggersignals freilaufend.
Zeitmassstäbe	0,5 s/DIV ... 50 ms/DIV	22 kalibrierte Stufen in 1-2-5 Folge. Nichtkalibriert: kontinuierliche Einstellung 1 : $\geqslant$ 2,5
Fehlergrenze	± 3 %	± 5 % für 0,5 s/DIV und 0,2 s/DIV ± 5 % für 100 ns/DIV und 50 ms/DIV

1.2.5. Verzögerte Zeitablenkung — Sofort nach Verzögerungszeit laufend oder triggerbar nach Verzögerungszeit

Zeitmassstäbe	1 ms/DIV ... 50 ns/DIV	14 kalibrierte Stufen in 1-2-5 Folge Nichtkalibriert, kontinuierliche Einstellung 1 : $\geqslant$ 2,5
Fehlergrenze	± 3 %	± 5 % für 100 ns/DIV und 50 ns/DIV
Dehnung der Zeitbasis	x 5	
Maximale effektive Schreibgeschwindigkeit	10 ns/DIV	
Zuzügliche Toleranz	± 2 %	

1.2.6. Triggerung der Hauptzeitablenkung

Triggerquelle	Intern Zusammengesetzt Netz Extern	von Kanal A, B, C oder D
Trigger-Bandbreite	DC ... 50 MHz	Obere Bandbreitegrenze –15 dB
Trigger-Empfindlichkeit	Intern $\leqslant$ 0,5 DIV Extern $\leqslant$ 250 mV	0,3 DIV typisch 150 mV typisch
Flankenwahl	+ oder –	
Ext. Triggereingangsimpedanz	1 Mohm//15 pF	Gleich dem Eingang einer beliebigen Vertikalablenkung
Eingangsspannung	± 400 V max.	DC + AC Spitze

1.2.7. Triggerung der verzögerten Zeitablenkung

Gleich der Hauptzeitablenkungstriggerung ausser:

Triggerquelle	Intern Zusammengesetzt	Von Kanal A, B, C oder D

Verzögerte Ablenkung

Verzögerungszeit	Stufenlos regelbar zwischen 0,3x und 10x der Zeitmassstab der Hauptzeitablenkung mit Helipotentiometer	

Benennung	*Beschreibung*	*Nähere Angaben*
Zusätzlicher Verzögerungs-zeitfehler	0,5 %	
Verzögerungszeitjitter	$\leqslant 1 : 20\,000$	

1.2.8. Kalibriereinheit

Spannung	3 $V_{s\text{-}s}$	Rechtecksignal, Grundlinie ist Null-spannung
Strom	6 mA	Durch Stromkreis
Fehlergrenze	± 1 %	Für Spannung und Strom
Frequenz	2 kHz	± 2 %
Sicherung	Der Ausgang ist kurzschlussfest	

1.2.9. Speisung

Netzspannungen	90 ... 270 V Wechselspannung (AC) oder 100 ... 350 V Gleichspannung (DC)	In einem Bereich
Netzfrequenz	46 ... 440 Hz oder DC	
Eingebaute Sicherung	1,6 A, träge	Für alle Netzspannungen
Leistungsaufnahme	29 W	

1.2.10. Einflussgrössen

Die angegeben Daten gelten nur dann, wenn das Gerät gemäss den offiziellen Prüfverfahren kontrolliert wurde. Einzelheiten, die dieses Verfahren und die Fehlergrenzenkriterien betreffen, können von der PHILIPS-Organisation Ihres Landes oder von N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPT., EINDHOVEN, HOLLAND angefordert werden.

Umgebungstemperaturen	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Betrieb innerhalb Spezifikation Arbeitsbereich Lagerung und Transport
Höhe	5000 m 15000 m	Betriebsfähig Nicht Betriebsfähig
Feuchtigkeit	Das Gerät entspricht den Anforderungen gemäss IEC 68 Db Standard	
Stossfestigkeit	1000 Stösse von 10 g, ½ Sinus, Dauer 6 ms, in allen 3 Richtungen	
Vibration	30 Minuten in jeder der drei Richtungen, 10-150 Hz; 0,7 mm (Spitze-Spitze) und 5 g maximale Beschleunigung	
Akklimationszeit	30 Minuten für Normalbetrieb	Kommend von −10 °C nach +20 °C bei 60 % relativer Feuchtigkeit
Störgrad	Das Gerät entspricht den Anforderungen gemäss VDE Störgrad K	

1.2.11. Mechanische Daten

Abmessungen	Länge 410 mm Breite 316 mm Höhe 154 mm	Ohne Bedienungsorgane, Deckel und Füsse
Gewicht	9,7 kg	

Benennung *Beschreibung* *Nähere Angaben*

1.2.12. Standardzubehör

Kontrastfilterscheibe
Abdeckhaube mit Aufbewahrungsraum
Faltbarer Lichtschutztubus PM 9366
BNC Übergangsstecker PM 9051
CAL Anschlussklemme - BNC Adapter
Anleitung
4 x 10:1 Messkopf PM 9350/PM 8927

1.2.13. Wahlzubehör

PM 9335	1:1 Messkopf 1,5 m Kabel
PM 9335L	1:1 Messkopf 2,5 m Kabel
PM 9350	10:1 Messkopf 1,5 m Kabel
PM 9350L	10:1 Messkopf 2,5 m Kabel
PM 8927	10:1 Messkopf 1,5 m Kabel
PM 8927L	10:1 Messkopf 2,5 m Kabel
PM 9358	100:1 Messkopf, 5600 V maks., 2 pF, 1,5 m Kabel
PM 9347	Aktiver T.V. Messkopf
PM 9352	Aktiver 10:1 Miniaturmesskopf 100 kohm//6 pF
PM 9353	Aktiver 2:1 FET-Messkopf 1 Mohm//3,5 pF
PM 9355	12 Hz ... 70 MHz Strom-Messkopf
PM 9346	Stromversorgung für aktive Messköpfe
PM 8960	19" Gestelleinbausatz
PM 8992	Zubehörtasche
PM 9380	Oszillografenkamera
PM 8971	Kamera Adapter für PM 9380
PM 8910	Polaroid Anti-Reflex Filter
PM 8980	Langer Einblicktubus
PM 8901	Batteriespeisung 24 V und 140 V Gleichspannung
PM 8991	Rollwagen

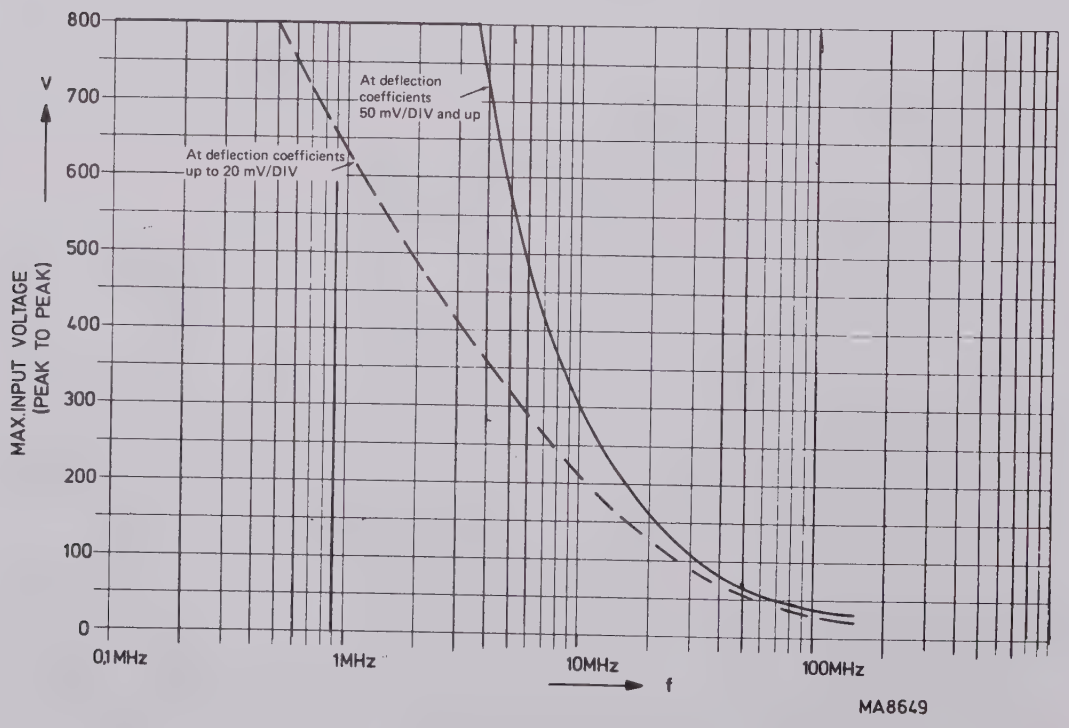


Abb. 1.2. Minderung der höchstzulässigen Eingangsspannung als Funktion der Frequenz

Abb. 2.1. Abnehmen der Abdeckhaube

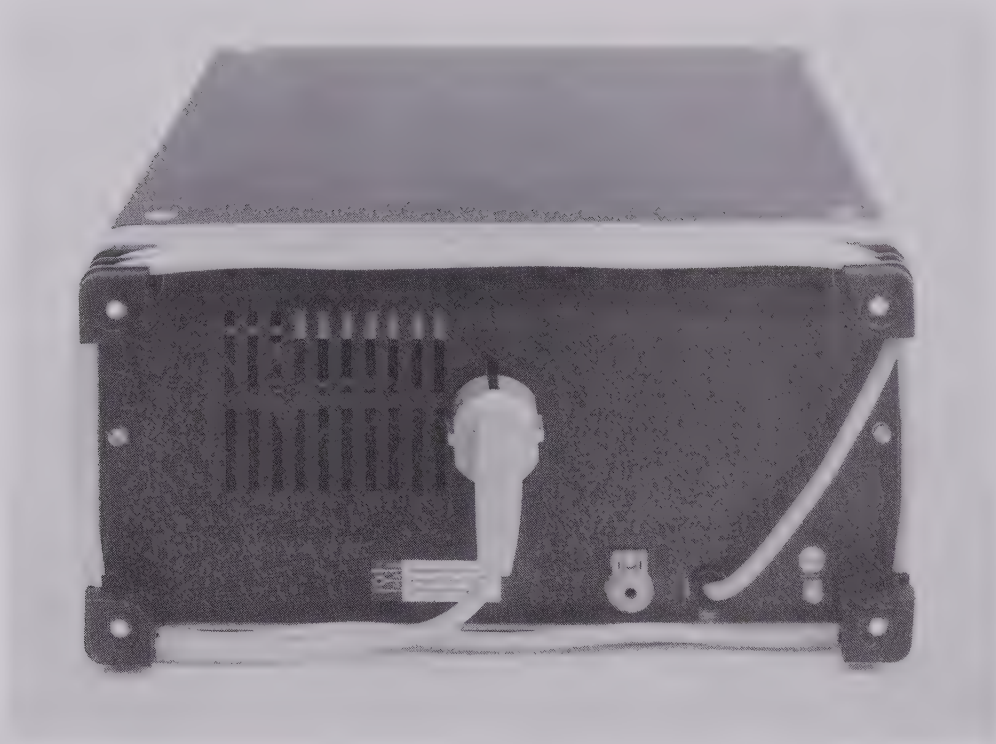


Abb. 2.2. Rückansicht des Gerätes

2.Gebrauchsanleitung

2.1. INBETRIEBNAHME

2.1.1. Abnehmen und Aufsetzen der Abdeckhaube

Abnehmen:
- Den Knopf in der Mitte des Deckels eine viertel Umdrehung nach links drehen (Stellung UNLOCKED).
- Deckel abnehmen.

Aufsetzen:
- Den Verriegelungsknopf in Stellung UNLOCKED drehen.
- Deckel an der Vorderseite des Oszillografen befestigen.
- Knopf eindrücken und eine viertel Umdrehung nach rechts drehen (Stellung LOCKED).

Bemerkung: Der Handgriff lässt sich drehen wenn die Druckknöpfe auf ihren Lagern eingedrückt werden.

WARNUNG: In diesem Gerät werden hohe Spannungen erzeugt, deshalb darf es niemals in geöffnetem Zustand eingeschaltet werden.
Vor Wartungsarbeiten ist der Netzstecker zu ziehen und ist darauf zu achten dass alle Hochspannung führenden Teile entladen sind.
Bevor irgend eine Verbindung ausgeführt wird muss die Erdanschlussklemme an einen Schutzleiter angeschlossen werden (siehe Abschnitt "Erdung").

2.1.2. Netzspannungseinstellungen und Sicherung

Da das Gerät bei jeder Netzspannung zwischen 90 und 270 V Wechselspannung und zwischen 100 und 350 V Gleichspannung betriebsfähig ist, erübrigt sich das Umschalten auf die örtliche Netzspannung.
Der Sicherungshalter ist an der Rückwand angebracht. Die Sicherung 1,6 A, träge wird bei allen Netzspannungen angewandt.
Es dürfen nur die vorgeschriebenen Sicherungen verwendet werden. Die Verwendung reparierter Sicherungen und das Kurzschliessen des Sicherungshalter sind nicht zulässig. Das Gerät muss von allen Spannungsquellen getrennt sein wenn eine Sicherung ersetzt wird.

2.1.3. Erdung

Vor dem Einschalten muss dass Gerät auf eine der folgenden Weisen mit einem Erdschutzleiter verbunden werden:
- über den Erdanschluss (gekennzeichnet ⏚).
- über das dreiadrige Netzkabel. Der Netzstecker darf nur in eine Schutzkontaktdose eingeführt werden. Diese Schutzmassnahme darf nicht unwirksam gemacht werden, z.B. durch Verwendung einer Verlängerungsleitung ohne Schutzleiter.

WARNUNG: Jede Unterbrechung des Schutzleiters innerhalb oder ausserhalb des Geräts ist unzulässig.
Wenn ein Gerät von kalter in warme Umgebung gebracht wird, kann dies zu einem sicherheitstechnisch gefährlichen Zustand führen. Deshalb sind alle Erdungsvorschriften sorgfältig zu beachten.

2.1.4. Öffnen des Geräts

Beim Öffnen von Abdeckungen oder Entfernen von Teilen mit Werkzeug können spannungsführende Teile freigelegt werden. Auch können Anschlussstellen spannungsführend sein.

Vor dem Öffnen des Geräts muss das Gerät von allen Spannungsquellen getrennt sein. Wenn danach eine Kalibrierung, Wartung oder Reparatur am geöffneten Gerät unter Spannung unvermeidlich ist, so darf das nur durch eine Fachkraft geschehen, welche die damit verbundenen Gefahren kennt.

Ersetzen des Netzsteckers geschieht auf eigene Gefahr. Nach dem Ersetzen des Netzsteckers ist es ratsam einen Hochspannungstest IEC 348 vorzunehmen.

Kondensatoren im Gerät können noch geladen sein, selbst wenn das Gerät von allen Spannungsquellen getrennt wurde.

2.1.5. Einschalten

Der Netzschalter POWER ist gekoppelt mit der Rasterbeleuchtungseinsteller ILLUM und befindet sich an der Vorderseite des Gerätes unter dem Bildröhrenrahmen.
Der Oszillograf darf niemals eingeschaltet werden, wenn eine Leiterplatte oder Baustein entfernt wurde.
Eine Leiterplatte oder Baustein darf nicht früher als eine Minute nach Ausschaltung des Gerätes entfernt werden.

2.2. BEDIENUNGSORGANE UND BUCHSEN

2.2.1. Vertikalablenkung (Y)

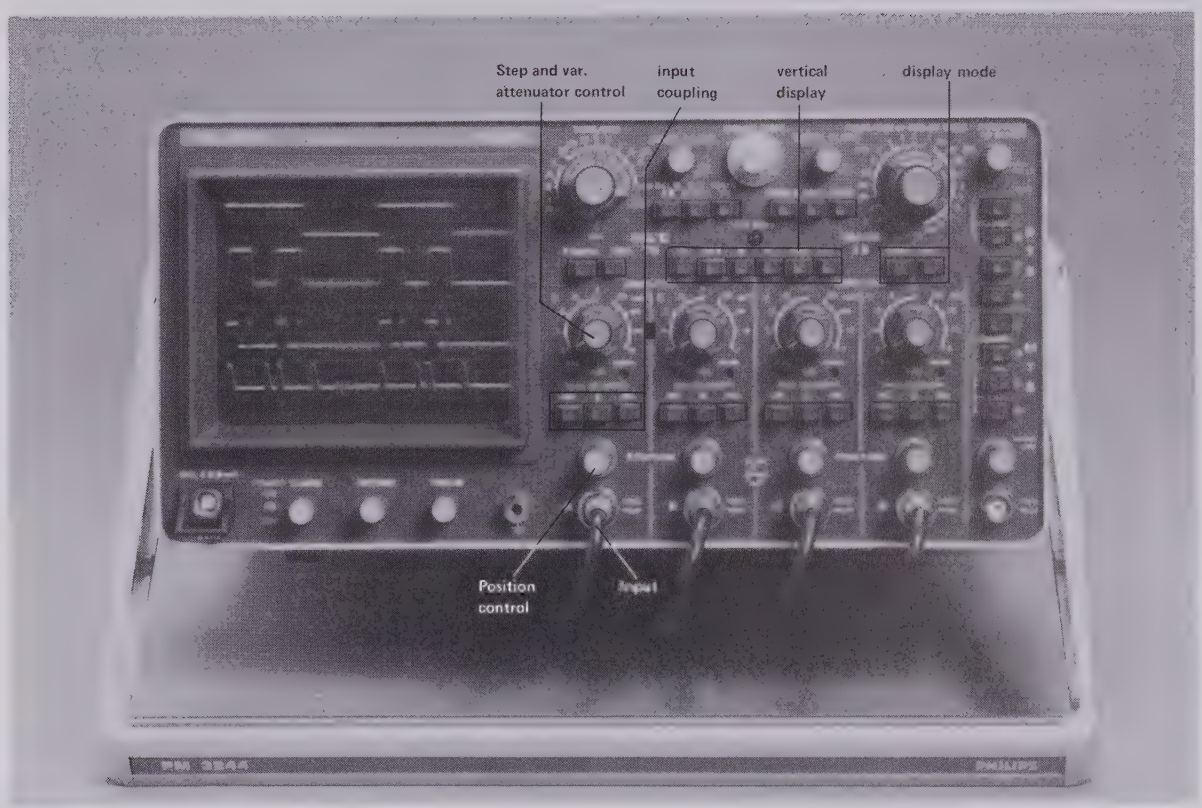


Abb. 2.3. Vertikalablenkung

1. Vertikalablenkungsart-Schalter

Taste A	Kanal A
Tasten A+B	Kanäle A und B algebraisch addiert
Taste B	Kanal B
Taste C	Kanal C
Tasten C+D	Kanäle C und D algebraisch addiert
Taste D	Kanal D

Jede Kombination obiger Darstellungsarten ist möglich.
Wenn keine Taste gedrückt ist, ist Kanal A eingeschaltet.

2. Darstellungsart Schalter CHOP/ALT

Die in Punkt 1 erwähnten Kanäle können gechopped oder alternierend dargestellt werden. Wenn keine Taste gedrückt ist und zwei oder mehr Kanäle eingeschaltet sind, dann ist die Darstellung gechopped.

3. Abschwächer-Einsteller

AMPL/DIV	Stufenweise Einstellung der Ablenkkoeffizienten, kombiniert mit:
AMPL/CAL	Stufenlose Einstellung der Ablenkkoeffizienten. Wenn dieser Knopf gezogen ist, wird die Polarität des Kanals invertiert.
Eingangskopplung-Schalter	AC Signalkopplung über einen Sperrkondensator O Kanaleingang geerdet, Signalleerlauf DC Direkte Kopplung (Wenn keine Taste eingedrückt ist, ist Einstellung AC wirksam.)
POSITION	Stufenlose Einstellung bewirkt vertikale Verschiebung des betreffenden Kanals.

VOREINSTELL-BEDIENUNGSORGANE

BAL	Ausgleich des Stufenabschwächergleichgewichtes
GAIN	Verstärkereinstellung des Stufenabschwächers

2.2.2. Horizontalablenkung (X)

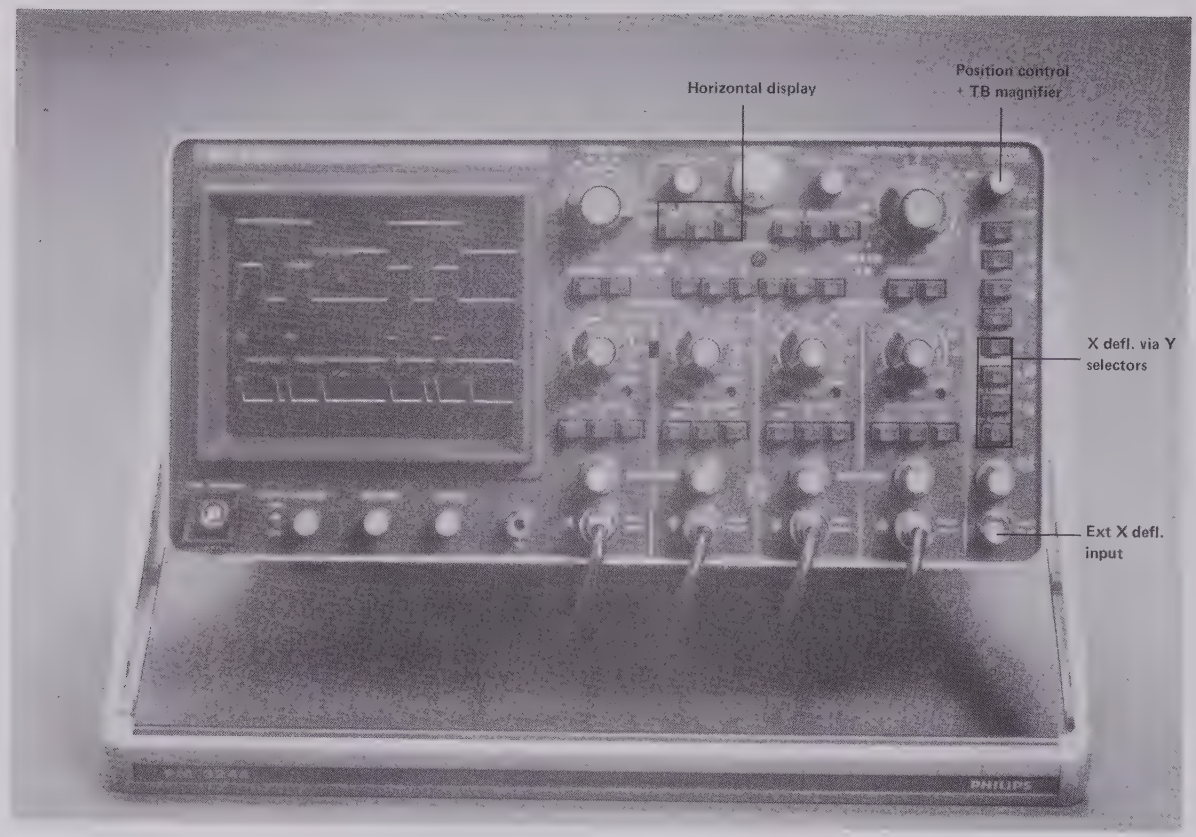


Abb. 2.4. Horizontalablenkung

1. Horizontalablenkungsart-Schalter

MAIN TB	Die Horizontalablenkung wird vom Hauptzeitablenkgenerator bewirkt. Ein Teil der Darstellung wird aufgehellt wenn die verzögerte Zeitablenkung eingeschaltet ist.
EXT X DEFL	Horizontalablenkung wird bewirkt durch ein Signal kommend von: – der Eingangsbuchse des Horizontalverstärkers – einem der vertikalen Kanäle oder – dem Netz
DEL'D TB	Die Horizontalablenkung wird vom verzögerten Zeitablenkgenerator bewirkt. Wenn keine Taste eingedrückt ist, dann gilt MAIN TB.

2. Position und Dehnung der Zeitablenkung

POSITION	Stufenlose Einstellung der horizontalen Verschiebung der Darstellung.
TB MAGN	Zug-Druck Schalter für 5-fache Steigerung der Zeitablenkkoeffizienten.

2.2.3. Hauptzeitablenkung

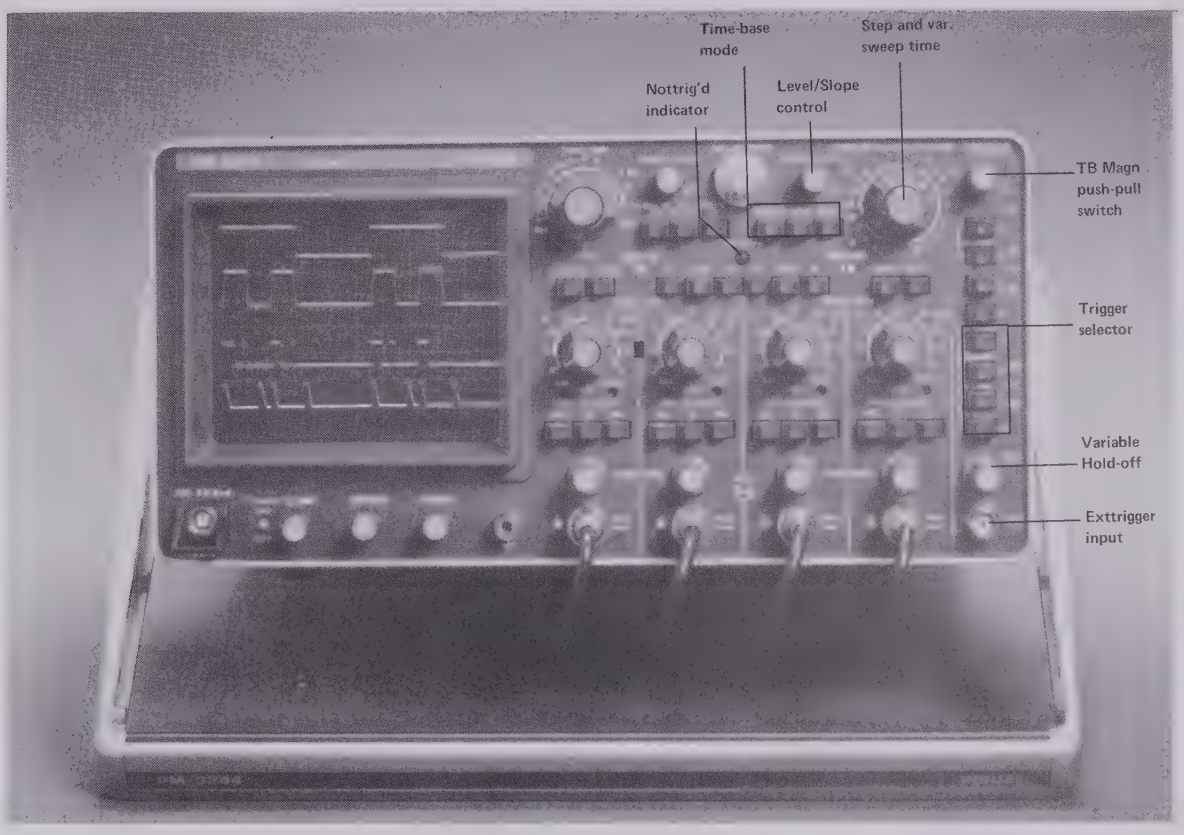


Abb. 2.5. Hauptzeitablenkung

1. Hauptzeitablenkung-Wahlschalter

AUTO	Wenn keine Triggerimpulse vorhanden sind, ist der Hauptzeitablenkgenerator freilaufend.
TRIG	Die Hauptzeitablenkung wird auf normale Weise getriggert.
SINGLE	Single sweep Zeitablenkung. Nach Betätigung der Taste Single läuft der Hauptzeitablenkgenerator nur einmal ab. Wenn keine Taste eingedrückt ist, arbeitet die Zeitablenkung in Betriebsart Single Sweep.

2. Schalter TIME/DIV or DELAY — Stufenweise Einstellung der Zeitkoeffizienten der Hauptzeitablenkung; Drehschalter mit 22 Stellungen. Wenn die verzögerte Zeitablenkung wirksam ist, dann ist die Verzögerungszeit nach der die verzögerte Zeitablenkung startet gegeben durch die Einstellung der Helipotentiometer "DELAY TIME" mal TIME/DIV Koeffizient dieses Schalters.

TIME/DIV CAL	Stufenlose Einstellung des Zeitkoeffizienten.

3. LEVEL/SLOPE — Stufenlose Einstellung zur Wahl des Triggerpegels bei welchem der Zeitablenkgenerator startet. Der Zug-Druckschalter gestattet Wahl der Triggerung auf der positiv oder negativ gerichteten Flanke des Signals.

4. Anzeige NOT TRIG'D — Leuchtet auf wenn keine Triggerung des Hauptzeitablenkgenerators erfolgt ist.

5. Hauptzeitablenkung Triggerquelle-Wahlschalter — Dieser Schalter besteht aus vier Tasten (A, B, C, D) für die Wahl des Triggersignals von einem der Vertikalablenkungskanäle. Wenn die beiden Tasten A und B eingedrückt sind, wird das zusammengesetzete Triggersignal gewählt. Wenn die beiden Tasten B und C eingedrückt sind, wird ein Teil der Netzspannung als Triggersignal verwendet.
Wenn die beiden Tasten C und D eingedrückt sind, wird das Signal welches an Buchse EXT liegt als Triggersignal verwendet. Falls keine Taste eingedrückt ist, ist Signal A eingeschaltet.

2.2.4. Verzögerte Zeitablenkung

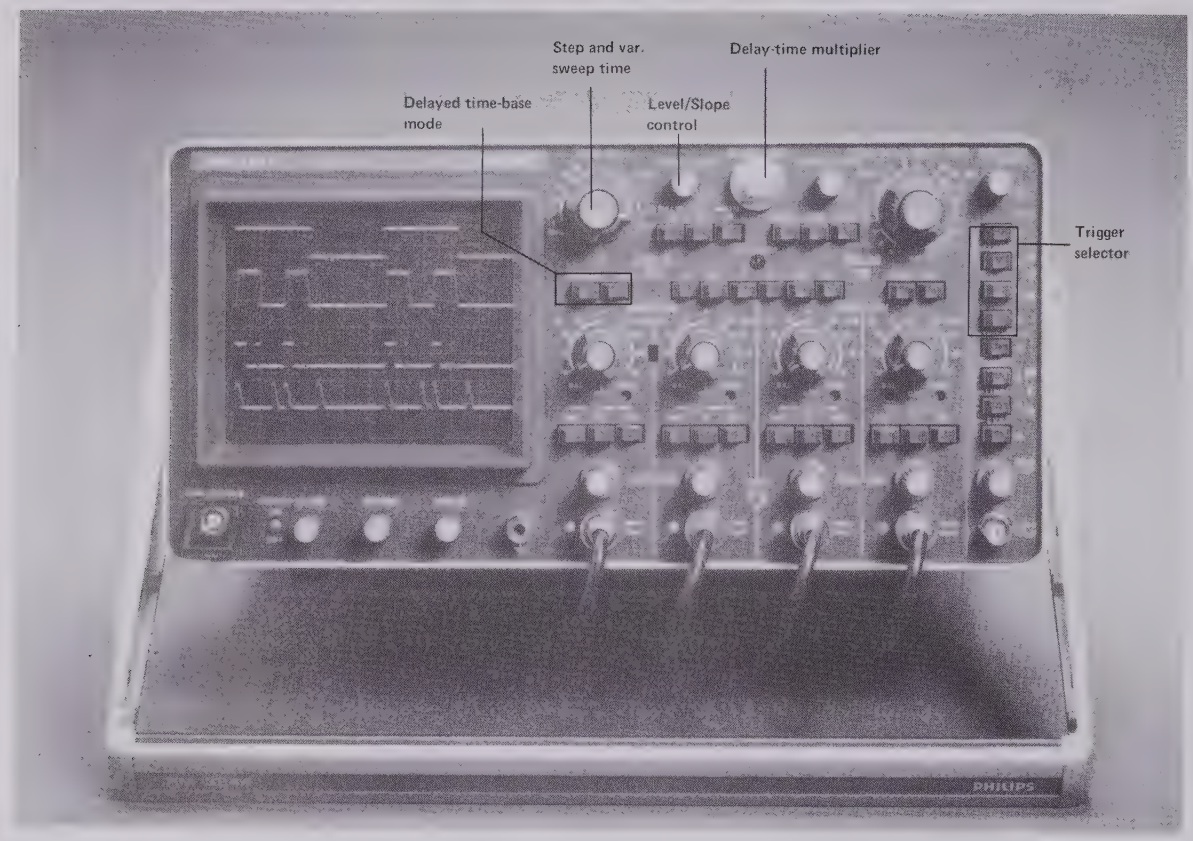


Abb. 2.6. Verzögerte Zeitablenkung

1. Schalter TIME/DIV

   Stufenweise Einstellung der Zeitkoeffizienten der verzögerten Zeitablenkung: Drehschalter mit 14 Stellungen. In Stellung OFF wird die verzögerte Zeitablenkung abgeschaltet.

   TIME/DIV CAL

   Stufenlose Einstellung der Zeitkoeffizienten der Zeitablenkung.

2. DELAY TIME

   Kalibrierter Helipotentiometer zur Einstellung der Verzögerungszeit, nach welcher der verzögerte Zeitablenkgenerator wirksam wird. Diese Verzögerungszeit ist gegeben durch die Einstellung DELAY TIME mal TIME/DIV Koeffizient der Hauptzeitablenkung.

3. STARTS/TRIG

   Wenn Taste STARTS eingedrückt ist, startet sofort nach der Verzögerungszeit die verzögerte Zeitablenkung (die verzögerte Zeitablenkung erfordert in diesem Falle kein Triggersignal). Wenn Taste TRIG eingedrückt ist startet die verzögerte Zeitablenkung nach der Verzögerungszeit nach Empfang eines Triggerimpulses. Keine Taste gedrückt hat die gleiche Wirkung wie Taste STARTS gedrückt.

4. LEVEL/SLOPE

   Stufenlose Einstellung zur Wahl des Triggerpegels bei welchem der verzögerte Zeitablenkgenerator getriggert wird. Der Zug-Druck Schalter gestattet Wahl der Triggerung auf der positiv oder negativ gerichteten Flanke des Signals.

5. Verzögerte Zeitablenkung Triggerquelle-Wahlschalter

   Dieser Schalter besteht aus vier Tasten (A, B, C und D) für die Wahl des Triggersignals von einem der Vertikalablenkungskanäle. Wenn die beiden Tasten A und B eingedrückt sind, wird das zusammengesetzte Triggersignal gewählt.
   Falls keine Taste eingedrückt ist, ist Signal A eingeschaltet.

2.2.5. Bildteil

1. POWER/ILLUM	Stufenlose Einstellung der Rasterbeleuchtung, kombiniert mit Ein/Aus-Netzschalter. Signallampe zeigt Betriebszustand (ON) an.
2. INTENS	Stufenlose Einstellung der Bildhelligkeit
3. FOCUS	Stufenlose Einstellung der Fokussierung des Elektronenstrahls.

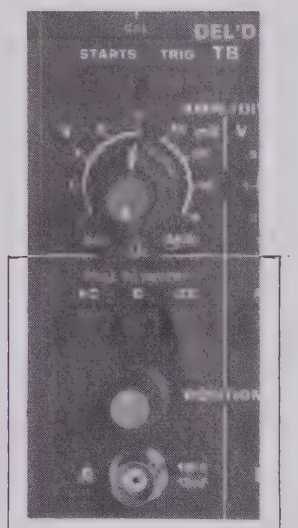
Verschiedenes

1. CAL	Ausgangsbuchse für die Kalibrierung: – der Verstärkung des Vertikalablenkverstärkers – der Frequenzkompensation von Abschwächer-Messköpfen. Geeignet für Spannungs-Messköpfe und Strommessköpfe.

2.3. GRUNDEINSTELLUNGEN

Bevor mit dem Oszillografen Messungen ausgeführt werden, muss man sich überzeugen dass der Stufenabschwächer-Ausgleich und die Verstärkungskalibrierung für alle Kanäle einwandfrei eingestellt sind.
Falls erforderlich, wie folgt handeln:

1. Einstellen des Stufenabschwächer-Gleichspannungsgleichgewichts
   - Taste MAIN TB des Horizontalablenkungsschalters eindrücken.
   - Taste AUTO des Hauptzeitablenkungsschalters eindrücken.
   - Mit Einstellern INTENSITY und FOCUS die Bildschärfe adjustieren.
   - Die entsprechende Kanaltaste des Vertikalablenkungsschalters eindrücken.
   - Taste 0 des Eingangskopplungsschalters eindrücken.
   - Mit Knopf POSITION das Bild derart einstellen, dass es sich ungefähr in der Mitte des Schirms befindet.
   - Den stufenlosen Einsteller AMPL auf CAL stellen.
   - Es ist darauf zu achten dass beim Drehen des Stufenschalters AMPL das Bild nicht springt.
     Wenn nötig, Regler BAL einstellen.
   - Den Vorgang für jeden Kanal wiederholen.
2. Verstärkungskalibrierung
   Wenn nicht anders erwähnt befinden sich die Einstellelemente in den gleichen Stellungen wie beim vorgehenden Verfahren.
   - Schalter AC-0-DC auf AC stellen.
   - Schalter AMPL auf 0,5 V und den stufenlosen Einsteller auf CAL stellen.
   - Kanaleingang mit Ausgang CAL verbinden.
   - Kontrollieren ob die Vertikalablenkung genau 6 Div. beträgt. Nötigenfall Regler GAIN adjustieren.
   - In diese Kalibrierung kann ein Abschwächer-Messkopf einbezogen werden. Der Abschwächfaktor des Messkopfs muss in Bezug auf die Stellung des Schalters AMPL in Betracht gezogen werden.
   - Den Vorgang für jeden Kanal wiederholen.



Att. step balance — Gain calibration

2.4. BEDIENUNGSANLEITUNGEN

2.4.1. Allgemeines

Vor dem Einschalten überzeuge man sich ob der Oszillograf einwandfrei den INBETRIEBNAHME Vorschriften gemäss (Abschnitt 2.1.) installiert ist und dass die erwähnten Sicherheitsmassnahmen eingehalten wurden.

2.4.2. Vertikalablenkung

Zur Darstellung der gewünschten Kanäle die entsprechenden Tasten des Vertikalablenkungsschalters eindrücken. Wenn zwei oder mehr Bildsignale dargestellt werden, kann die Darstellung in alternierender oder gechoppter Betriebsart erfolgen. In der alternierenden Betriebsart werden die Kanäle hintereinander dargestellt; beim Rücklauf der Hauptzeitablenkung wird die Darstellung von einem Kanal auf den anderen umgeschaltet.

In der gechoppten Betriebsart werden die Kanäle während der Zeitablenkung von einem auf den anderen umgeschaltet. In der gechoppten Betriebsart ist die Darstellungszeit ca. 500 ns pro Kanal. Ab /03 Version; 0,5 und 2 μs, schaltbar, siehe Abb. 3.18.
Für eine gute Darstellung ist es üblich bei höheren Ablenkgeschwindigkeiten die alternierende Betriebsart anzuwenden und bei niedrigeren Ablenkgeschwindigkeiten die gechoppte.
Es ist zu beachten dass bei zusammengesetzter Triggerungsart die alternierende Darstellung gewählt wird, weil sonst die Chopperimpulse die Triggerschaltung beeinflussen.
Die zu beobachtenden Signale sind an die Buchse (n) A ... D zu legen und der AC/0/DC Schalter ist abhängig von der Zusammensetzung der Signale auf AC oder DC zu stellen. Da der vertikale Verstärker gleichspannungsgekoppelt ist, ist die ganze Bandbreite des Gerätes verfügbar und die Gleichspannungskomponenten werden in Stellung DC des AC/0/DC-Schalters als Bildverschiebungen sichtbar.
Sind kleine Signale hohen Gleichspannungen überlagert kann dies störend sein. Jede Abschwächung des Signals verursacht auch eine Abschwächung der kleinen Wechselspannungskomponenten. In diesem Falle ist der Eingangsschalter in AC Stellung zu bringen wodurch ein Sperrkondensator die Gleichspannungs- und Niederfrequenz-Signale unterdrückt. Dies hat Dachschräge zur Folge bei Darstellungen von Niederfrequenzsignalen.
Stellung 0 unterbricht das Signal und erdet den Verstärkereingang um den 0 V Pegel schnell bestimmen zu können.
Mit Hilfe der Einsteller POSITION lässt sich die Darstellung in vertikaler Richtung verschieben. Es ist zu beachten, dass bei zusammengesetzter Triggerungsart der Trigger-Startpunkt von der vertikalen Verschiebung beeinflusst wird.

2.4.3. Horizontalablenkung

Abhängig von der Stellung des Horizontalablenkungsschalters ist folgende Horizontalablenkung möglich:
- Hauptzeitablenkung
- Ext. X-Ablenkung
- Verzögerte Zeitablenkung

Mit Einsteller POSITION kombiniert mit der Dehnung der Zeitablenkung kann die Darstellung in horizontaler Richtung verschoben werden.

Wenn Taste MAIN TB oder DEL'D TB eingedrückt ist, wird die Horizontalablenkung von der Hauptzeitablenkung bezw. der verzögerten Zeitablenkung bewirkt. Wenn Taste EXT X DEFL eingedrückt ist, wird Horizontalablenkung bewirkt durch:
- Einen der Vertikalablenkungskanäle A, B, C oder D
- Netzspannung
- Extern über Buchse EXT

2.4.4. Hauptzeitablenkung

Lineare Horizontalablenkung ist verfügbar wenn Taste MAIN TB der Horizontaldarstellungsschalter eingedrückt ist.
Die Betriebsart der Zeitablenkung ist mit den folgenden Schaltern wählbar:

AUTO
- Zeitablenkung freilaufend, auch wenn keine Triggerimpulse anliegen. Folglich ist das Bild immer sichtbar.
  Betriebsart AUTO kann in allen Fällen verwendet werden, in welchen auch Betriebsart TRIG anwendbar ist, ausgenommen bei Signalfrequenzen niedriger als 10 Hz oder Impulsreihen mit einer "AUS" Zeit über 100 ms. Sobald Triggerimpulse vorhanden sind, wird der Freilauf der Zeitablenkung automatisch beendet und wird der Zeitablenkgenerator normal getriggert.

TRIG
- Die Zeitablenkung wird sichtbar sobald Triggerimpulse vorhanden sind und die Triggerpegeleinstellung korrekt ist.

SINGLE
- Die Zeitablenkung läuft nach Empfang eines Triggerimpulses nur einmal ab. Nach diesem "Sweep" muss die Zeitablenkung durch Eindrücken der Taste SINGLE erneut eingestellt werden.
  Wenn einmalige Vorgänge beobachtet (und in der Regel fotografiert) werden müssen, ist es oft wünschenswert dafür zu sorgen, dass nur ein Sägezahn erzeugt wird, selbst wenn möglicherweise nach Darstellung dieses Vorgangs mehrere Triggerimpulse erzeugt würden.

2.4.5. Triggerung

Wenn ein oder mehrere Signale dargestellt werden sollen, muss um ein stillstehendes Bild zu erhalten, die Zeitablenkung immer an einem festen Punkt des Signals gestartet werden.
Der Zeitablenkgenerator wird deshalb von Triggerimpulsen gestartet, die abhängig von der Stellung des Hauptzeitbasis-Triggerquelle-Wahlschalter, folgenden Signalquellen entstammen:
- Einer der Vertikalablenkungskanäle A, B, C oder D
- Zusammengesetztes Signal
- Netzspannung
- Externe Spannung

Die Amplitude der Triggersignale von einem der Vertikalablenkungskanäle, oder vom zusammengesetzten Signal ist proportional zur Vertikalablenkung des Bildes und daher von der Einstellung des Eingangsabschwächer abhängig.

Für zusammengesetzte Triggerung müssen die Taste A und B eingedrückt werden. Bei dieser Betriebsart wird das Triggersignal dem gemeinsamen Vertikalablenkungsverstärker entnommen.
Zusammengesetzte Triggerung ermöglicht:
a. Triggerung durch Differenzsignale, mit beispielsweise dem Gerät in Betriebsart A+B und mit einer der Eingangsspannungen invertiert.
b. Darstellung von zwei bis vier Signalen mit verschiedenen Frequenzen ohne Beziehung zueinander. In diesem Fall müssen die Triggerpunkte der verschiedenen Signale im gleichen Triggerpegelbereich liegen.

Bemerkung: — *Bei Triggerung in der zusammengesetzten Betriebsart, muss die Darstellung immer in Betriebsart ALT erfolgen.*
In Betriebsart CHOP wirken die Chopper-Impulse als Triggerimpulse und verursachen dadurch ein unstabiles Bild.
— *Bei zusammengesetzter Triggerung wird der Triggerpunkt des Signals auch vom Vertikaleinsteller POSITION bestimmt. Eine kleine Modifikation für "AC" zusammengesetzte Triggerung löst dieses Problem. Beschreibung (nur in Englisch) im Abschnitt 3.2.2.*

Netztriggerung wird durch Eindrücken der beiden Tasten B und C bewirkt.
Die Hauptzeitablenkung wird von einem Teil der Netzspannung getriggert. Die Kopplung mit der Netzspannung wird mit Hilfe einer optischen Trennschaltung erlangt, dadurch bleibt das Gerät von der Netzspannung isoliert.
Externe Triggerung wird durch Eindrücken der beiden Tasten C und D bewirkt.
Die Hauptzeitablenkung wird nun von einem an BUCHSE EXT angelegten externen Signal getriggert.
Mit Einsteller LEVEL ist der Triggerpunkt auf der Flanke des Signals wählbar.
Der Zug-Druck Schalter SLOPE erlaubt die Wahl der positiv oder negativ gerichteten Flanke.
Wenn der Hauptzeitbasisgenerator keine Triggerimpulse erhält, dann leuchtet Anzeige NOT TRIG'D auf.

Im SINGLE SWEEP-Betrieb leuchtet diese Anzeige wenn der Zeitablenkgenerator erneut eingestellt wurde und das Erscheinen des nächsten Triggerimpulses erwartet.

Die Ablenkzeit der Hauptzeitablenkung wird mit Knopf TIME/DIV or DELAY TIME eingestellt. Wenn die verzögerte Zeitablenkung eingeschaltet ist, dann ist die Zeit zwischen dem Start der Hauptzeitablenkung und der verzögerten Zeitablenkung vom Produkt der Einstellung des 10-Drehungsknopfes DELAY TIME mal der Einstellung des Ablenkzeitschalters MAIN TB gegeben.

Mit dem inneren Knopf lassen sich Zeitablenkzeiten zwischen den Stufen einstellen. Für Zeitmessungen muss dieser Knopf immer auf CAL stehen.
Der Koeffizient TIME/DIV der Zeitablenkung lässt sich durch Ziehen des Zug-Druck Schalters TB MAGN 5-fach dehnen.

Mit Einsteller HOLD OFF lässt sich die Sperrzeit des Hauptzeitablenkgenerators variieren. Dies ist die Zeit die der Zeitablenkgenerator benötigt bis er zum Empfang des nächsten Triggerimpulses bereit ist. Einsteller HOLD OFF ermöglicht eine stabile Darstellung von komplizierteren Signale, z.B. periodische Doppelimpulse. Der normale Stand des Einstellers HOLD OFF ist Rechtsanschlag. Linksdrehung erweitert die Sperrzeit.

2.4.6. Verzögerte Zeitablenkung

Wenn Taste MAIN TB des Schalters für die horizontale Darstellung eingedrückt ist und der Knopf TIME/DIV der verzögerten Zeitablenkung nicht in Stellung OFF ist, wird ein Tell der Hauptzeitablenkungslinie zusätzlich aufgehellt.
Der Zeitpunkt des Starts der verzögerten Zeitablenkung wird von den Einstellungen des Knopfs TIME/DIV der Hauptzeitablenkung und des 10-Drehungsknopfes DELAY TIME bestimmt. Wenn Taste STARTS des Schalters

der verzögerten Zeitablenkungsart eingedrückt ist, dann startet die verzögerte Zeitablenkung sofort nach der Verzögerungszeit.
Wenn Taste TRIG eingedrückt ist startet die verzögerte Zeitablenkung nach der Verzögerungszeit und nach Erhalt eines Triggerimpulses.
Der Triggerwähler der verzögerten Zeitablenkung besitzt die gleichen Möglichkeiten wie der Triggerwähler der Hauptzeitablenkung mit Ausnahme von LINE und EXT Triggerart.
Die Funktion des Einstellers LEVEL/SLOPE ist die gleiche wie für die Hauptzeitablenkung beschrieben.
Die Zeitdauer des zusätzlich aufgehellten Teils der Hauptzeitablenkung wird von der Einstellung des Knopfs TIME/DIV der verzögerten Zeitablenkung bestimmt.
Mit dem inneren Knopf lassen sich die Ablenkzeiten zwischen den Stufen einstellen. Für Zeitmessungen muss dieser Knopf immer auf CAL gestellt werden.
Wenn Taste DEL'D TB der horizontalen Darstellung eingedrückt ist wird der zusätzlich aufgehellte Teil über die gesamte Schirmbreite sichtbar gemacht.

Notice d'emploi et d'entretien

1. Generalites

1.1. INTRODUCTION

L'oscilloscope portatif haute fréquence PM 3244 présente quatre voies identiques de déviation verticale à haute sensibilité (5 mV/div) et sur une largeur de bande étendue de 50 MHz.

Il y a un large choix de déviations verticales possibles: une, deux, trois ou quatre voies (alternées ou découpées). De plus, les deux premières voies peuvent être additionnées et aussi les deux dernières voies. La polarité de chaque voie peut être inversée.

Pour ce qui est des déviations horizontales possibles, on distingue: la déviation de base de temps principale (avec ou sans base de temps retardée intensifiée), la déviation de base de temps retardée ou la déviation externe.

Si l'on excepte la source de déclenchement normal, le PM 3244 offre un déclenchement composite.

Cet oscilloscope se caractérise par une alimentation à faible dissipation fonctionnant pour une tension alternative entre 90 et 270 V ou pour une tension continue entre 100 et 350 V.

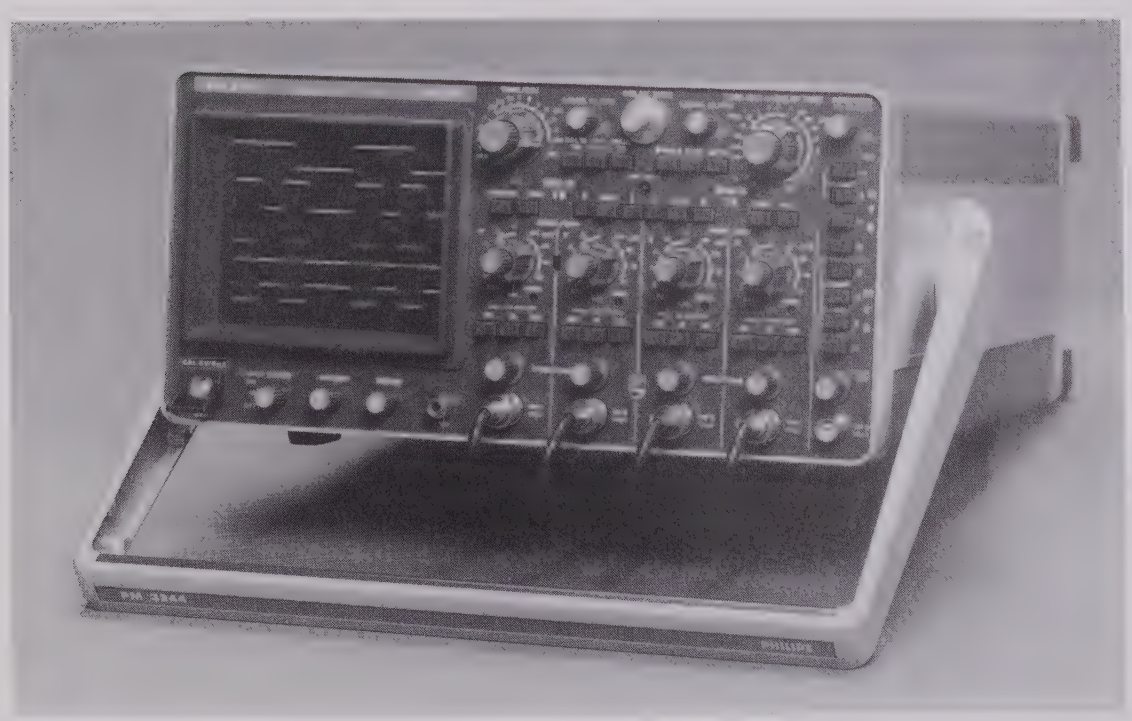


Fig. 1.1. Oscilloscope portatif à quatre voies PM 3244

1.2. CARACTERISTIQUES TECHNIQUES

Les spécifications sont valables après que l'appareil a été préchauffé pendant 15 minutes.
Les valeurs indiquées avec tolérance sont garanties. Les chiffres sans tolérance ne servent qu'à titre d'information et correspondant aux charactéristiques d'un appareil moyen.

Cet appareil a été conçu et testé conformément à la norme C.E.I. 348 pour appareils de classe I. A sa livraison il répond aux règles de sécurité. La présente notice comporte les informations et les avertissements nécessaires à l'utilisateur afin d'assurer le fonctionnement de l'appareil dans les conditions de sécurité et de le maintenir conforme à la norme.

Désignation	*Spécification*	*Information supplémentaire*
1.2.1. Tube à rayons cathodiques		
Type	PHILIPS D14-125 GH/08	Tube à face rectangulaire, type domed mesh, post-accélérateur, couche phosphore doublée de métal
Aire de mesure	80 mm x 100 mm	
Type d'écran	Phosphore P31 (GH)	en option, couche phosphore P11 (BE) ou P7 (GM)
Vitesse d'écriture photographique	$\geqslant$ 750 cm/μs	Mesuré avec un appareil photographique Steinheil Oscillophot M5 Ouverture: 1:1,2 Rapport objet/image: 1:0,5 Film: Polaroid 410 (10000 ASA) pas de pré-voilage Phosphore du type P31 (GH)
Tension d'accélération totale	10 kV	
Graticule	Divisions 8 x 10 cm avec subdivisions de 2 mm sur les axes centraux.	Les lignes interrompues indiquent les points 10 % et 90 % pour la mesure du temps de montée.
Illumination de graticule	Continuellement variable	Luminosité maximale nettement visible dans les conditions d'éclairage normales de laboratoire.
1.2.2. Déviation verticale (Y)		
Nombre de voies	4	Quatre voies identiques, A, B, C et D
Modes d'affichage	Voie A seulement Voie B seulement Voie C seulement Voie D seulement Voies A+B additionnées Voies C+D additionnées Ces modes peuvent tous être découpés ou alternés. Toutes les voies peuvent être inversées.	
Temps d'affichage par voie en mode découpé	Environ 500 ns	A partir de la version /03: 0,5 ou 2 μs, commutable. Voir fig. 3.18.
Gamme de fréquence	Continu à 50 MHz	Couplage continu Largeur de bande supérieure –3 dB
	10 Hz à 50 MHz	Couplage capacitif Largeur de bande supérieure –3 dB
Temps de montée	7 ns	
Dépassement	± 2 % max.	Impulsion d'essai avec temps de montée 1 ns, déviation de 6 divisions et temps de répétition de 1 μs

Désignation	*Spécification*	*Information supplémentaire*
Coefficients de déviation	5 mV/DIV à 2 V/DIV	En 9 positions étalonnées (progression 1-2-5), avec commande non-calibrée continue 1: ⩾ 2,5 par potentiomètre
Précision	± 3 %	
Tension d'entrée	± 400 V max.	Tension continue + crête de tension alternative. En positions 5 mV/DIV à 20 mV/DIV de l'atténuateur d'entrée réduction de la tension d'entrée maximale admise à fréquences > 500 kHz. Voir Fig. 1.2.
Déviation maximale	24 divisions ⩾ 6 divisions	Pour tensions sinusoïdales jusqu'à 15 MHz Pour tensions sinusoïdales de 15 MHz à 50 MHz
Amplitude totale maxi en modes A-B et C-D	24x réglage d'atténuateur	Atténuateurs en position CAL
Gamme de décadrage	16 divisions	
Réjection en mode commun	⩾ 100:1 à 1 MHz	Après de réglage
Diaphonie entre voies	35 dB max.	Pour toutes combinaisons d'atténuateurs. La référence est 6 div. d'amplitude (0 à 50 MHz), mode découpé.
Instabilité, dérive de trace	⩽ 0,3 div/h à 20 °C	Après 15 min. de pré-chauffage
Dérive de température	⩽ 60 µV/°C typique	
Balance d'atténuateur	⩽ 0,3 div	En commutant entre positions d'atténuateur
Entrée		
Impédance	1 Mohm//15 pF	
Couplage	AC-0-DC	
Temps RC	22 msec	Commutateur de couplage sur "AC"
Retard de signal visible	20 nsec	

1.2.3. Déviation horizontale (X)

Modes d'affichage	– Base de temps principale – Base de temps principale intensifiée par base de temps de retardée – Base de temps retardée – Fonctionnement X/Y	Fonctionnement X/Y quatre traces avec déviation X par une des 4 voies verticales, un signal externe ou le signal d'alimentation

Amplificateur de déviation horizontale

Largeur de bande	Continue à 1 MHz	Sur 6 divisions Limite supérieure –3 dB
Coefficient de déviation	450 mV/div Coefficients d'atténuateur vertical	A l'aide de l'entrée EXT S'appliquent lorsqu'une des voies verticales est utilisée à la déviation horizontale
Précision	± 10 %	Utilisant un canal vertical pour déviation horizontal
Impédance d'entrée	1 Mohm//15 pF	

	Désignation	*Spécification*	*Information supplémentaire*
	Différence de phase entre ampl. de déviation vert. et ampl. de déviation horizontale	inférieure à 3°	à 100 kHz
	Déviation par tension secteur	8 divisions	La déviation dépend de la tension secteur et est réglé sur 8 DIV pour tension secteur 220 V à l'usine
1.2.4.	**Base de temps principale**		
	Fonctionnement	Automatique Déclenché Balayage unique	En mode automatique, la base de temps est en fonctionnement libre env. 100 ms. après la disparition du signal de déclenchement.
	Coefficients de temps	0,5 s./DIV ... 50 ms./DIV	En 22 positions étalonnées (progression 1-2-5) Commande continue non-étalonnée 1 : ⩾ 2,5
	Précision	± 3 %	± 5 % pour 0,5 s/DIV et 0,2 s/DIV ± 5 % pour 100 ns./DIV et 50 ms./DIV
1.2.5.	**Base de temps retardée**	Démarre immédiatement après le temps de retard ou est déclenchable après le temps de retard	
	Coefficients de temps	1 ms./DIV ... 50 ns./DIV	En 14 positions étalonnées (progression 1-2-5) Commande continue non-étalonnée 1 : ⩾ 2,5
	Précision	± 3 %	± 5 % pour 100 ns./DIV et 50 ns./DIV
	Agrandisseur de base de temps		
	Agrandissement	x5	
	Vitesse de balayage efficace maximale	10 nsec/DIV	
	Tolérance supplémentaire	± 2 %	
1.2.6.	**Déclenchement de la base de temps principale**		
	Source	Interne Composite Secteur Externe	A partir de la voie A, B, C ou D
	Largeur de bande de déclenchement	Continu à 50 MHz	Limite supérieure −15 dB
	Sensibilité de déclenchement	Interne ⩽ 0,5 DIV Externe ⩽ 250 mV	0,3 DIV typique 150 mV typique
	Sélection de pente	+ ou −	
	Impédance d'entrée pour déclenchement externe	1 Mohm//15 pF	Identique pour chaque entrée de déviation verticale
	Tension d'entrée	± 400 V max.	Tension continue + crête de tension alternative

1.2.7. Déclenchement de la base de temps retardée

Identique au déclenchement de la base principale sauf:

Source	Interne Composite	A partir de la voie A, B, C ou D
Retard de balayage		
Temps de retard	Continuellement variable entre 0,3x et ⩾ 10x le coefficient de temps de la base de temps principale	Réglable à l'aide d'un potentiomètre 10-tours
Erreur supplémentaire du temps de retard	0,5 %	
Jitter du temps de retard	⩽ 1 : 20.000	

1.2.8. Unité d'étalonnage

Tension	3 V_{cc}	Onde carrée, ligne de base 0 V
Courant	6 mA	Par le boucle de courant
Précision	± 1 %	Pour la tension et le courant
Fréquence	2 kHz ± 2 %	
Protection	La sortie est exempte de courts-circuits.	

1.2.9. Alimentation

Tensions secteur	90 ... 270 V en alternatif ou 100 ... 350 V en continu	En une gamme
Fréquence secteur	46 ... 440 Hz ou continu	
Fusible secteur incorporé	1,6 A action différée	Pour toutes tensions secteur
Consommation	29 W	

1.2.10. Données d'environnement

Les données d'environnement ne s'appliquent que lorsque l'appareil est contrôlé conformément aux processus officiels. Pour plus de détails sur ces processus et les critères de panne, s'adresser à l'organisation Philips locale ou à N.V. Philips' Gloeilampenfabrieken, Test and Measuring Department, Eindhoven, Holland.

Température ambiante	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Gamme nominale d'utilisation Gamme limite de fonctionnement Gamme d'emmagasinage et de transport
Altitude	5 000 m 15 000 m	Fonctionnement A l'arrêt
Humidité	L'appareil répond aux normes IEC 68 Db	
Choc	1000 chocs de 10 g, ½ sinusoïde, durée 6 ms, dans chacune des trois directions	
Vibration	30 min. dans chacune des trois directions, 10-150 Hz; 0,7 mm crête-à-crête et 5 g accélération maximale	
Temps de rétablissement	30 minutes (en fonctionnement normal)	quand l'appareil passe de −10 °C à +20 °C à 60 % d'humidité relative
Perturbation electromagnétique	L'appareil répond aux normes VDE, Störgrad K	

1.2.11. Caractéristiques mécaniques

Dimensions	Longueur 410 mm	Non compris commandes, couvercle et pieds
	Largeur 316 mm	
	Hauteur 154 mm	
Poids	9,7 kg	

1.2.12. Accessoires livrés avec l'appareil

Filtre de contraste
Couvercle frontale avec remplacements pour accessoires
Visière pliante PM 9366
Adaptateur BNC banane PM 9051
Borne CAL - Adaptateur BNC
Notice d'emploi et d'entretien
4x Sonde 10:1 PM 9350/PM 8927

1.2.13. Accessoires en option

PM 9335	Sonde 1:1, câble 1,5 m
PM 9335L	Sonde 1:1, câble 2,5 m
PM 9350	Sonde 10:1, câble 1,5 m
PM 9350L	Sonde 10:1, câble 2,5 m
PM 8927	Sonde 10:1, câble 1,5 m
PM 8927L	Sonde 10:1, câble 2,5 m
PM 9358	Sonde 100:1, 5,6 kV max. 200 Mohm//2 pF
PM 9347	Sonde T.V. active, 10:1, 11 pF
PM 9352	Sonde miniature active 10:1 100 kohm//6 pF
PM 9353	Sonde FET active 2:1 1 Mohm//3,5 pF
PM 9355	Sonde de courant 12 Hz ... 70 MHz
PM 9346	Alimentation de sonde
PM 8960	Jeu pour montage en rack 19''
PM 8992	Sacoche pour accessoires
PM 9380	Appareil de photographie d'oscillogrammes
PM 8971	Adapteur de caméra pour PM 9380
PM 8910	Filtre Polaroid
PM 8980	Visière longue
PM 8901	Jeu de batteries
PM 8991	Chariot

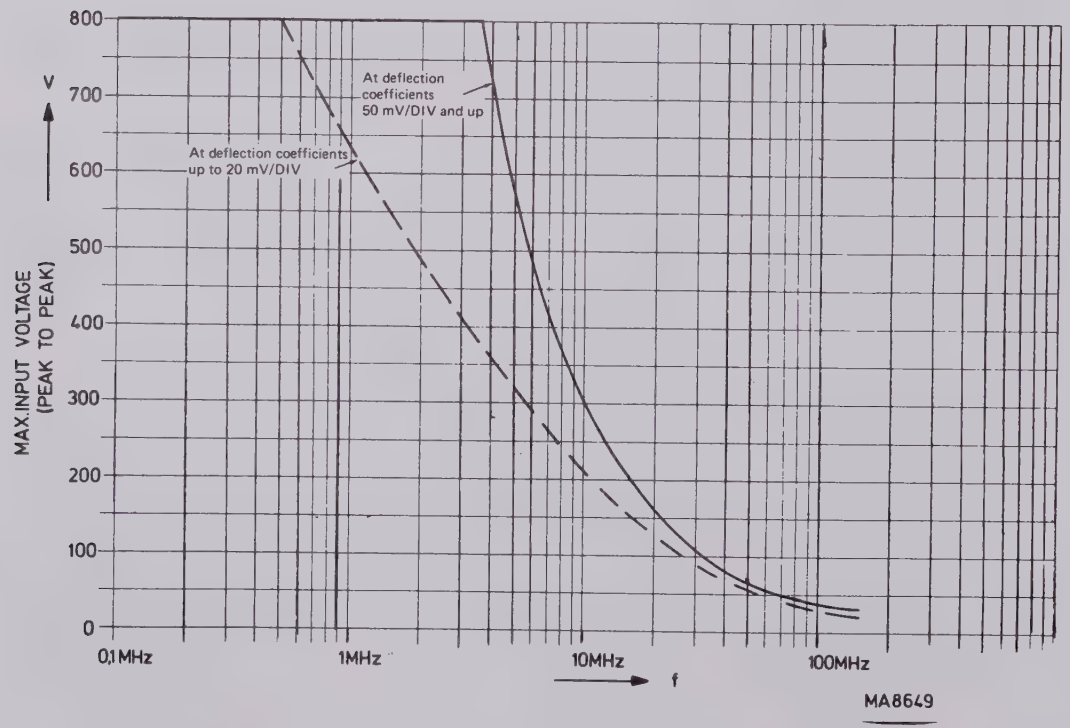


Fig. 1.2. Réduction de la tension d'entrée maximale en fonction de la fréquence

Fig. 2.1. Dépose du couvercle frontal

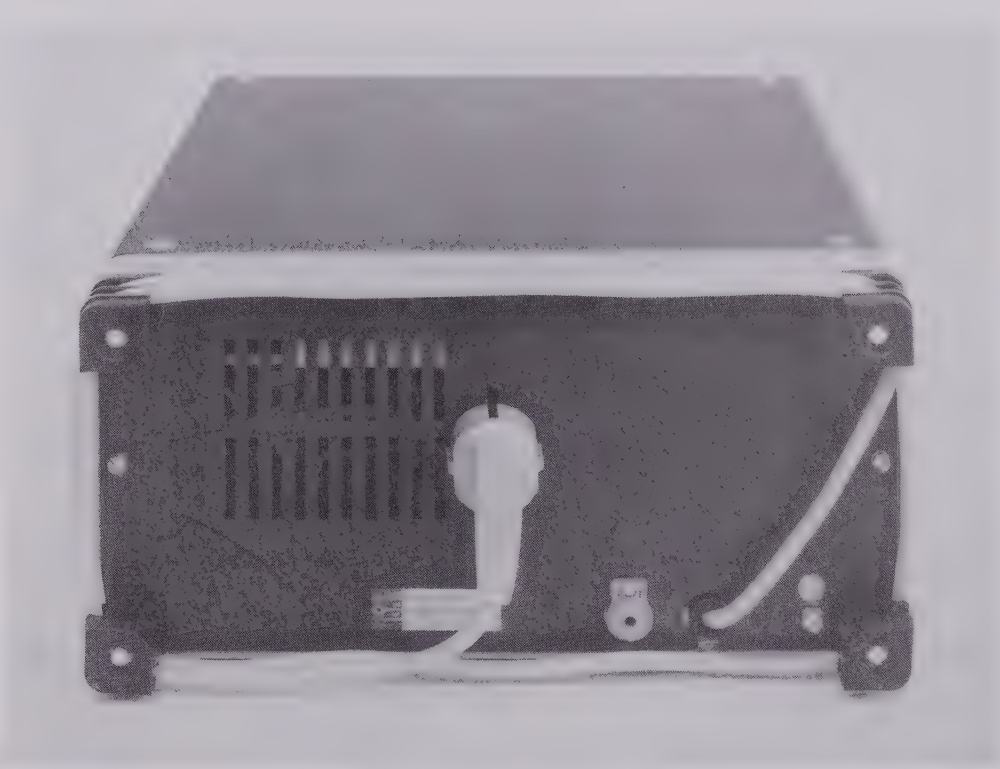


Fig. 2.2. Vue arrière de l'appareil

2. Mode d'emploi

2.1. INSTALLATION

2.1.1. Démontage et montage du couvercle frontal

Démontage:
- Tourner le bouton au centre du couvercle d'un quart de tour vers la gauche (position UNLOCKED).
- Enlever le couvercle.

Montage:
- Tourner le bouton de verrouillage vers position UNLOCKED
- Fixer le couvercle sur la partie avant de l'oscilloscope.
- Enfoncer le bouton et le tourner d'un quart de tour vers la droite (position LOCKED).

Remarque: Pour faire pivoter la poignée, il faut enfoncer les boutons-poussoirs aux étriers.

ATTENTION: Le présent appareil produit des tensions élevées et ne peut donc pas être utilisé avec les plaques du châssis déposées. La fiche secteur doit être enlevée et tous les points haute tension déchargés avant de procéder à n'importe quel travail d'entretien.
Avant de procéder à toute autre connexion, la borne de terre de l'appareil doit être reliée à la ligne de terre du réseau (voir mise à la terre).

2.1.2. Adaption à la tension secteur et fusible

La capacité d'utilisation à toute tension secteur comprise entre 90 et 270 V alternatif ou entre 100 et 350 V continu supprime la nécessité d'adapter le PM 3244 à la tension secteur locale.
La porte-fusible monté sur le panneau arrière porte un fusible à action retardée de 1,6 A (pour toute tension réseau).
S'assurer que des fusibles correctement calibrés et du modèle convenable sont utilisés en cas de remplacement. Il faut éviter d'utiliser des fusibles réparés et de court-circuiter des porte-fusibles. En cas de remplacement d'un fusible l'appareil doit être débranché de toutes sources de tension.

2.1.3. Mise à la terre

Avant toute mise sous tension, l'appareil doit être connecté à la terre de l'une des manières suivantes:
- Par la borne de terre de l'appareil (symbole ⏚).
- Par le cordon secteur à trois conducteurs. La fiche secteur ne doit être introduite que dans une prise possédant un contact de terre. La mise à la terre ne doit pas être éliminée par l'emploi d'un câble prolongateur sans conducteur de terre.

ATTENTION: Toute interruption de la ligne de terre, à l'intérieur ou à l'extérieur de l'appareil ou le débranchement de la borne de terre peuvent rendre l'appareil dangereux. L'interruption intentionnelle est formellement interdite.
Lorsqu'un appareil passe d'un endroit froid à un endroit chaud, la condensation peut provoquer un certain risque. En conséquence, il faut appliquer strictement les prescriptions de mise à la terre.

2.1.4. Démontage

L'ouverture des capots ou la dépose d'organes, à l'exception de ceux directement accessibles à la main sont susceptibles de mettre à jour des composants et des connecteurs sous tension.

L'appareil doit être débranché de toute source de tension avant de procéder à un réglage, un remplacement, une opération d'entretien ou une réparation demandant l'ouverture de l'appareil.

Au cas où le réglage, l'entretien ou la réparation de l'appareil ouvert sous tension sont inévitables, seule une personne qualifiée peut se charger de cette tâche.

Le remplacement d'une fiche secteur se fait aux risques et périls de l'utilisateur. Après le remplacement d'une fiche secteur, un test haute tension conforme à la norme CEI 348 est fortement recommandé.

Ne pas oublier que les condensateurs à l'intérieur de l'appareil peuvent être chargés, même si l'appareil est déconnecté de toute source de tension.

2.1.5. Enclenchement

Le commutateur POWER est incorporé dans la commande d'illumination de graticule ILLUM (panneau avant), juste sous le bord de l'écran.
L'oscilloscope ne doit jamais être enclenché lorsqu'une platine ou un bloc a été enlevé. Ne déposer de platine ou de bloc qu'une minute au moins après la mise hors service de l'oscilloscope.

2.2. BOUTONS, DOUILLES ET LEURS FONCTIONS

2.2.1. Déviation verticale

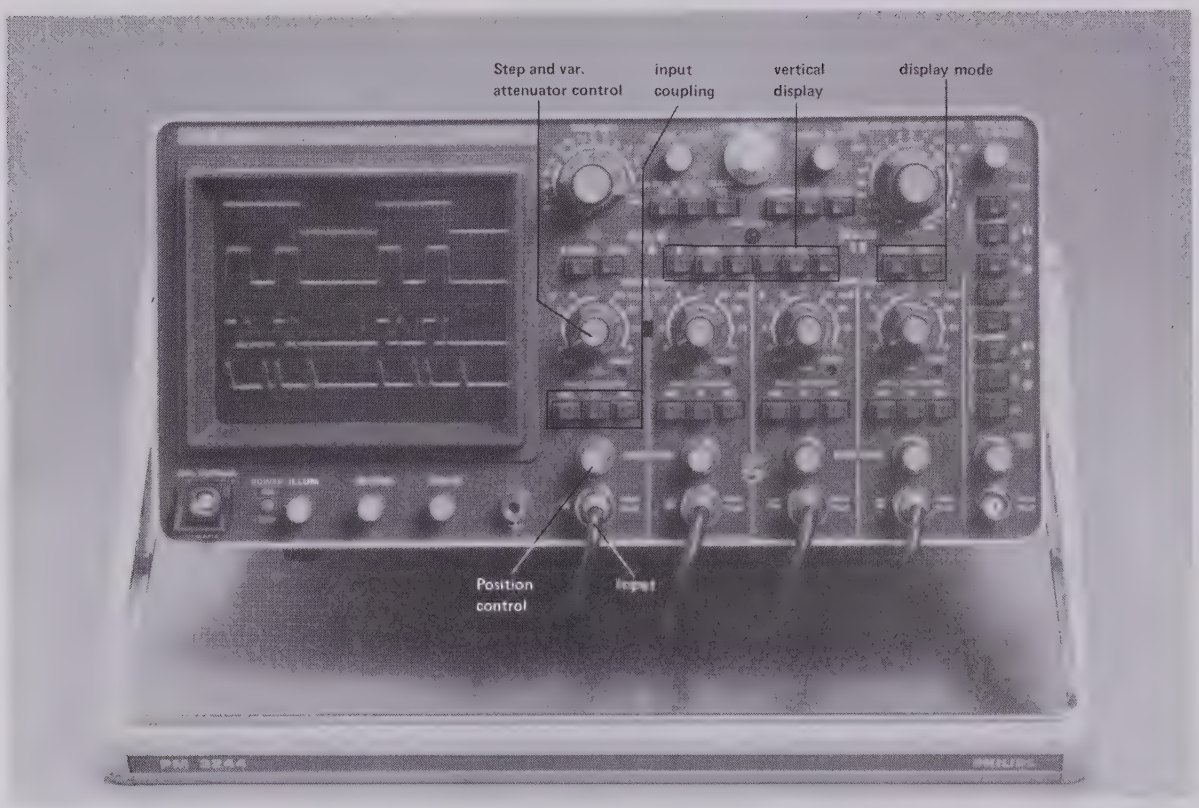


Fig. 2.3. Déviation verticale

1. Sélecteur de déviation verticale

Bouton A	voie A
Boutons A+B	voies A et B additionnés algébriquement
Bouton B	voie B
Bouton C	voie C
Boutons C+D	voies C et D additionnés algébriquement
Bouton D	voie D

Toute combinaison des affichages précités est possible. Si aucun bouton n'est enfoncé, la voie A est enclenchée.

2. CHOP-ALT commutateur

Les affichages mentionnés en peuvent être utilisés en mode découpé ou alterné, en fonction de la position du commutateur CHOP-ALT. Si aucun bouton n'est enfoncé et que deux voies ou plus sont enclenchées, l'affichage est en mode découpé.

3. Commandes d'atténuateur

AMPL/DIV	Commande échelonnée des coefficients de déviation combinée avec:
AMPL/CAL	Commande continûment variable des coefficients de déviation. Si ce bouton est tiré, la polarité de voie est inversée.
Commutateur de couplage d'entrée	AC Couplage de signal par l'intermédiaire d'un condensateur de blocage 0 Entrée de voie connectée à la terre; charge interrompue DC Couplage direct Si aucun bouton n'est enfoncé, AC est obtenu.
POSITION	Commande continûment variable indiquant le décadrage vertical de la voie en question.

COMMANDES DE PRE-REGLAGE

BAL	Equilibrage de l'atténuateur par échelons
GAIN	Etalonnage d'amplitude de l'atténuateur par échelons

2.2.2. Déviation horizontale

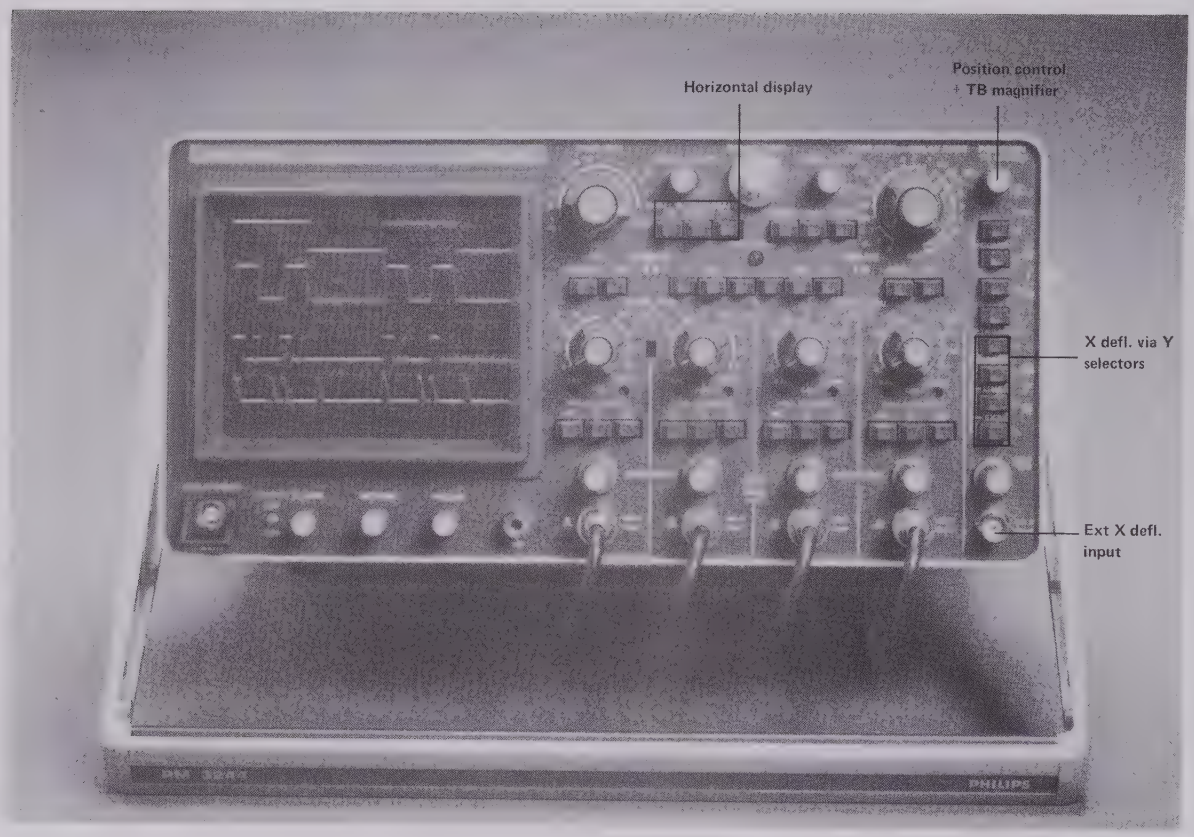


Fig. 2.4. Déviation horizontale

1. Sélecteur de déviation horizontale

MAIN TB	La déviation horizontale est fournie par le générateur de base de temps principale. Une partie de l'affichage est intensifié lorsque la base de temps retardée est mise en service.
EXT X DEFL	La déviation horizontale est obtenue à partir d'un signal externe provenant: – de la borne d'entrée de l'amplificateur horizontal – d'une des voies de déviation verticale – du réseau
DEL'D TB	La déviation horizontale est fournie par le générateur de base de temps retardée. Si aucun bouton n'est enfoncé, la base de temps principale est enclenchée.

2. Positionnement et agrandisseur de base de temps

POSITION	Commande continûment variable pour décadrage horizontal de l'affichage
TB MAGN	Commutateur push-pull qui augmente le coefficient de déviation horizontale d'un facteur 5. Cet effet est nul en mode EXT X DEFL.

2.2.3. Base de temps principale

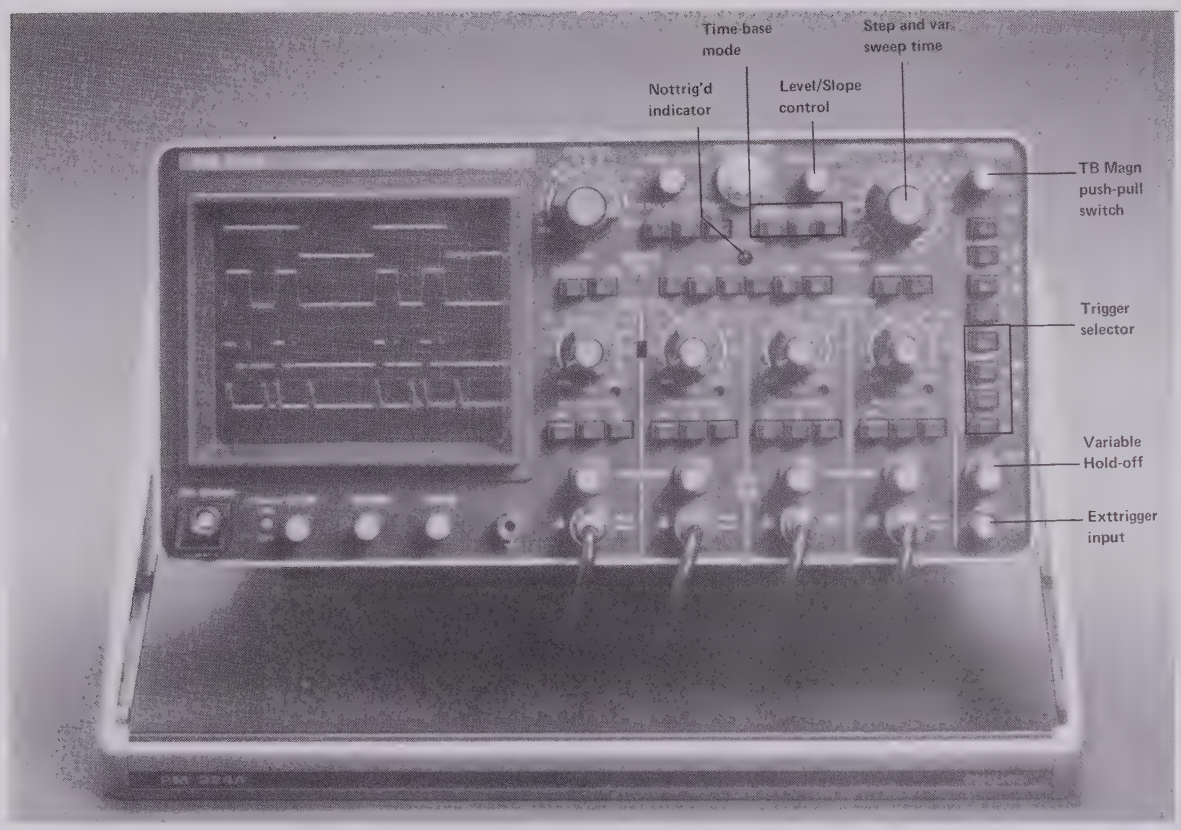


Fig. 2.5. Base de temps principale

1. Sélecteur de base de temps principale

AUTO	Le générateur de base de temps principale est en fonctionnement libre en l'absence de signaux de déclenchement.
TRIG	Le générateur de base de temps est déclenché normalement.
SINGLE	Le générateur de base de temps ne démarre qu'une seule fois à la réception d'une impulsion de déclenchement. Si aucun bouton n'est enfoncé, l'appareil fonctionne en mode SINGLE.

2. Commutateur TIME/DIV or DELAY — Commande par échelons des coefficients de temps pour la base de temps principale; commutateur rotatif à 22 positions. Si la base de temps retardée est en service, le temps de retard, à l'issue duquel la base de temps démarre, est égal au réglage étalonné DELAY TIME x le coefficient TIME/DIV de ce commutateur.

TIME/DIV CAL	Commande continûment variable des coefficients de temps.

3. LEVEL/SLOPE — Commande continûment variable pour sélectionner le niveau de déclenchement auquel le générateur de base de temps démarre. Le commutateur "push-pull" permet de choisir le déclenchement soit sur la pente positive, soit sur la pente négative du signal.

4. Indicateur NOT TRIG'D — S'allume lorsque le générateur de base de temps principale n'est pas déclenché.

5. Sélecteur de source de déclenchement de la base de temps principale — Ce commutateur comporte quatre boutons (A, B, C et D) servant à sélectionner le signal de déclenchement en provenance d'une des voies de déviation verticale. Lorsque les boutons A et B sont enfoncés, le signal de déclenchement composite est sélectionné. Lorsque les boutons B et C sont enfoncés, une partie de la tension réseau sert de signal de déclenchement. Lorsque les boutons C et D sont enfoncés, le signal appliqué au connecteur EXT sert de signal de déclenchement. Si aucun bouton n'est enfoncé, le signal de déclenchement A est disponible.

2.2.4. Base de temps retardée

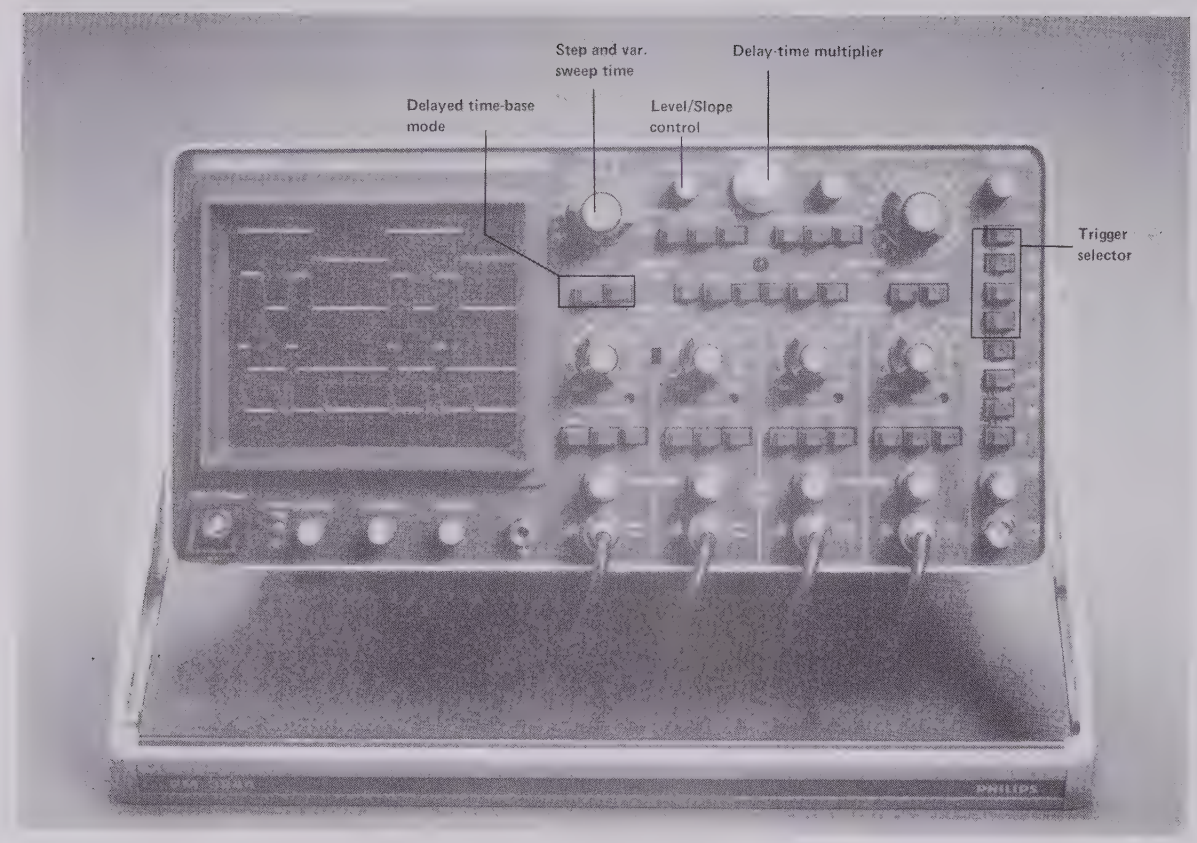


Fig. 2.6. Base de temps retardée

1. Commutateur TIME/DIV

   Commande par échelons des coefficients de temps pour la base de temps retardée; commutateur rotatif à 14 positions. Comprend une position OFF, grâce à laquelle le générateur de base de temps retardée est déclenchée.

   TIME/DIV CAL

   Commande continûment variable des coefficients de la base de temps.

2. DELAY TIME

   Potentiomètre étalonné à 10 tours pour ajuster le temps de retard, après quoi la base de temps retardée est mis hors service. Ce temps de retard est égal au réglage DELAY TIME x le coefficient TIME/DIV de la base de temps principale.

3. STARTS/TRIG

   Lorsque le bouton STARTS est enfoncé, la base de temps retardée démarre immédiatement après le temps de retard, car elle ne requiert aucun signal de déclenchement.
   Lorsque le bouton TRIG est enfoncé, la base de temps retardée démarre à la réception d'une impulsion de déclenchement après le temps de retard.
   Si aucun bouton n'est enfoncé, on obtient le même effet que STARTS enfoncé.

4. LEVEL/SLOPE

   Commande continûment variable qui permet de sélectionner le niveau du signal de déclenchement auquel le générateur de base de temps retardée démarre. Cette commande comprend un commutateur push-pull qui permet de démarrer sur le front positif ou négatif du signal de déclenchement.

5. Sélecteur de source de déclenchement de la base de temps retardée

   Ce commutateur comporte quatre boutons (A, B, C et D) servant à sélectionner le signal de déclenchement en provenance d'une des voies de déviation verticale. Lorsque les boutons A et B sont enfoncés, le signal de déclenchement composite est sélectionné.
   Si aucun bouton n'est enfoncé, le signal de déclenchement A est disponible.

2.2.5. Tube à rayons cathodiques

1. POWER/ILLUM	Commande continûment variable de l'illumination de graticule; comprend le commutateur secteur. La lampe témoin indique la position ON.
2. INTENS	Commande continûment variable pour la brillance de la trace.
3. FOCUS	Commande continûment variable pour la focalisation du faisceau.

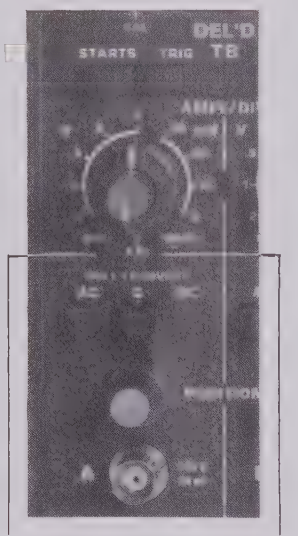
Divers

1. CAL	Douille de sortie pour étalonnage: – du gain de l'amplificateur de déviation verticale – de la compensation de fréquence des sondes atténuatrices Appropriée pour sondes de tension et de courant.

2.3. REGLAGES PRELIMINAIRES

Avant de procéder à des mesures à l'aide du présent oscilloscope, vérifier si l'équilibrage et l'étalonnage de gain de l'atténuateur par échelons sont adéquatement ajustés pour toutes les voies.
Au besoin, procéder comme suit:

1. Equilibrage continu de l'atténuateur par échelons
   - Enfoncer le bouton MAIN TB du sélecteur de déviation horizontale.
   - Enfoncer le bouton AUTO du sélecteur de base de temps principale.
   - Régler les commandes INTENSITY et FOCUS afin d'obtenir une trace nette et fine.
   - Enfoncer le bouton de voie appropriée du sélecteur de déviation verticale.
   - Enfoncer le bouton 0 du commutateur de couplage d'entrée.
   - Régler le bouton POSITION de telle sorte que la trace se trouve quelque part au centre de l'écran.
   - Mettre la commande continue AMPL sur CAL.
   - Vérifier si la trace ne saute pas lorsque le commutateur AMPL est tourné. Au besoin, ajuster la commande BAL.
   - Répéter ce processus pour chaque voie.
2. Etalonnages du gain
   A moins qu'indiqué différemment, les commandes occupent les mêmes positions que pendant le processus décrit ci-avant.
   - Mettre le commutateur AC-0-DC en position AC.
   - Régler la commande AMPL sur .5 V et la commande continue sur CAL.
   - Connecter l'entrée de voie à la sortie CAL.
   - Vérifier si la déviation verticale est de 6 divisions exactement. Au besoin, régler la commande GAIN.
   - Une sonde atténuatrice peut êgalement être incluse à cet étalonnage. Dans ce cas, il faut tenir compte du facteur d'atténuation de la sonde en fonction de la position du commutateur AMPL.
   - Répéter ce processus pour chaque voie.



Att. step balance — Gain calibration

2.4. INSTRUCTIONS DE COMMANDE

2.4.1. Généralités

Avant d'enclencher l'appareil, s'assurer que l'oscilloscope est réglé conformément aux recommandations d'installation (section 2.1.) et que les précautions décrites ont été observées.

2.4.2. Déviation verticale

Pour représenter les voies requises, il faut enfoncer les boutons correspondants du sélecteur de déviation verticale. Si deux traces ou plus sont affichées, l'affichage peut se faire soit en mode découpé, soit en mode alterné.
En mode alterné, les voies sont affichées successivement; pendant le retour du spot de la base de temps principale, l'affichage est commuté d'une voie à l'autre. En mode découpé, les voies sont commutées de l'une à l'autre pendant le balayage de la base de temps.

Le temps d'affichage en mode découpé est d'environ 500 ns. A partir de la version /03: 0,5 ou 2 μs, commutable, voir fig. 3.18.

Pour obtenir un affichage constant on utilise généralement le mode alterné à grandes vitesses de balayage et le mode découpé à petites vitesses de balayage.
A remarquer qu'en mode de déclenchement composite, il faut choisir le mode alterné, si non les impulsions de découpage exerceraient une certaine influence sur le circuit de déclenchement.

Les signaux observés sont appliqués aux prises d'entrées A ... D et le commutateur AC/0/DC est réglé soit sur AC soit sur DC en fonction de la composition du signal. Du fait que l'amplificateur vertical est couplé directement, tout la bande passante de l'appareil est disponible et les composantes continues sont affichées comme des décalages de trace en position DC du commutateur AC/0/DC. Ceci peut ne pas convenir lorsque de petits signaux superposés à des tensions continues doivent être représentés. Chaque atténuation du signal résulte en une atténuation de la petite composante alternative.
Le remède à cet état est d'utiliser la position AC du commutateur d'entrée, lequel comprend un condensateur de liaison servant à supprimer les signaux continus et basse fréquence. lorsque des signaux rectangulaires à basse fréquence sont représentés, on obtient une certaine pente de toit.

En position 0 le signal est interrompu et l'entrée de l'amplificateur est mise à la terre, sur cette position, le niveau 0 V est rapidement déterminé.

Les commandes de positionnement permettent de décadrer l'affichage en sens vertical. A remarquer qu'en mode de déclenchement composite le point de démarrage du déclenchement est également influencé par la commande de position verticale.

2.4.3. Déviation horizontale

Selon la position du sélecteur de déviation horizontale, la déviation peut être fournie par:
- la base de temps principale
- une source de signal externe
- la base de temps retardée

La commande de positionnement avec agrandisseur de base de temps permet de décadrer l'affichage en sens horizontal.

Si le bouton MAIN TB or DEL'D TB est enfoncé, la déviation horizontale est déterminée par la base de temps principale ou par la base de temps retardée. Au cas où le botuon EXT X DEFL est enfoncé, la déviation horizontale peut être obtenue à partir:
- d'une des voies de déviation verticale A, B, C ou D
- de la tension réseau (secteur)
- d'une source externe par l'intermédiaire du connecteur EXT.

2.4.4. Base de temps principale

La déviation horizontale linéaire est obtenue lorsque le bouton MAIN TB de l'affichage horizontal commuté est enfoncé.
Le mode de base de temps est choisi à l'aide du sélecteur de base de temps principale.

AUTO
- La base de temps fonctionne librement, même si aucune impulsion de déclenchement n'est disponible.
  La trace reste visible.
  Le mode AUTO peut être choisi dans tous les cas où le mode TRIG est applicable, sauf pour des fréquences inférieures à 10 Hz ou des trains d'impulsions ayant un temps supérieur à 100 ms.
  Dès que des impulsions de déclenchement sont disponibles, le fonctionnement libre de la base de temps est automatiquement achevé et le générateur est déclenché normalement.

TRIG
- La base de temps est visible lorsque des impulsions de déclenchement sont disponibles et que le niveau de déclenchement est exact.

SINGLE
- La base de temps n'effectue qu'un balayage à la réception d'une impulsion de déclenchement. Ensuite, la base de temps doit être remise à zéro en enfonçant à nouveau le bouton SINGLE.
  Lorsque des effets uniques sont observés (par exemple par photographie), il faut s'assurer qu'un seul balayage est engendré, même si plusieurs impulsions de déclenchement doivent être produites après le phénomène en question.

2.4.5. Déclenchement

Si un ou plusieurs signaux doivent être affichés, le balayage de la base de temps doit toujours être démarré en un point fixe du signal afin d'obtenir un affichage stationnaire.
A cet effet, le générateur de base de temps est démarré par des impulsions de déclenchement dérivées des sources suivantes, en fonction de la position du sélecteur de source de déclenchement pour base de temps principale:
- une des voies de déviation verticale A, B, C ou D
- un signal composite
- la tension réseau
- une source de tension externe.

Les amplitudes des signaux de déclenchement provenant d'une des voies de déviation verticale ou du signal composite sont proportionnelles à la déviation verticale de l'affichage, car dépendant des réglages de l'atténuateur d'entrée.

Pour le déclenchement composite, les boutons A et B doivent être enfoncés. Dans ce mode, le signal de déclenchement est pris de l'amplificateur de déviation verticale commune, Le déclenchement de signal composite se caractérise par:

a. Le déclenchement par signaux différentiels, par ex. si l'appareil est en mode A+B, l'une des tensions d'entrée étant inversées.
b. Deux à quatre signaux de fréquences différentes et sans rapport, qui peuvent être affichés.
   Dans ce cas, les points de déclenchement des différents signaux doivent se trouver dans la même gamme de niveau de déclenchement.

Remarque: — Lorsque le déclenchement est en mode composite, l'affichage doit toujours se faire en mode alterné. En mode découpé, les impulsions de découpage fonctionnent comme impulsions de déclenchement et l'affichage est instable.
— En mode de déclenchement composite, le point de déclenchement du signal dépend également de la commande POSITION verticale. Pour déclenchement composite en alternatif (AC) une petite modification decrite à la section 3.2.2. (seulement en Anglais) resout ce problème.

Le déclenchement réseau s'effectue en enfonçant les boutons B et C.
Le base de temps principale est déclenchée par une partie de la tension réseau (secteur). Le couplage avec la tension réseau est obtenue par un circuit opto-isolateur incorporé, de sorte que l'appareil reste isolé de la tension réseau.

Le déclenchement externe s'effectue en enfonçant les boutons C et D.
La base de temps principale est alors déclenchée par un signal externe appliqué par l'intermédiaire du connecteur EXT.
La commande LEVEL permet de sélectionner le point de déclenchement sur la pente du signal.
Le commutateur "push-pull" SLOPE permet de sélectionner la pente positive ou négative.

Si le générateur de base de temps principale ne reçoit aucune impulsion de déclenchement, le témoin NOT TRIG'D s'allume. En mode de balayage SINGLE, ce témoin s'allume lorsque le générateur de base de temps a été remis à zéro et est en position d'attente (impulsion de déclenchement suivante).

Le temps de balayage de la base de temps principale est réglé à l'aide du bouton TIME/DIV or DELAY TIME. Si la base de temps retardée est enclenchée, le temps entre le démarrage du balayage de base de temps principale et celui de la base de temps retardée est déterminé par le bouton à 10 tours DELAY TIME (1) et le commutateur du temps de balayage pour la base de temps principale (2): temps = réglage (1) x réglage (2). Le bouton central permet d'ajuster les temps de balayage de la base de temps entre les échelons. Pour les mesures de temps, ce bouton doit toujours être en position CAL.

Le coefficient TIME/DIV de la base de temps peut être accru d'un facteur 5 en tirant le bouton "push-pull" TB MAGN.

La commande HOLD OFF permet de faire varier le temps de blocage du générateur de base de temps principale. Il s'agit du temps dont le générateur a besoin pour être prêt à la réception de l'impulsion de déclenchement suivante. La commande HOLD OFF permet l'affichage constant de signaux plus complexes, comme par exemple les impulsions périodiques doubles.
La position extrême droite est considérée comme la position normale de la commande HOLD OFF. En position extrême gauche, le temps de blocage est étendu.

2.4.6. Base de temps retardée

Si le bouton MAIN TB pour affichage horizontal est enfoncé et que le bouton TIME/DIV de la base de temps retardée n'est pas en position OFF, une partie de la ligne de balayage pour base de temps principale est affichée à intensité accrue.
Le moment de démarrage de la base de temps retardée est déterminé par les réglages du bouton TIME/DIV de la base de temps principale et du bouton à 10 tours DELAY TIME. Si le bouton STARTS du sélecteur de base de temps retardée est enfoncé, la base de temps retardée démarre immédiatement après ce temps de retard.
Si le bouton TRIG est enfoncé, la base de temps retardée est démarrée après ce temps de retard et à la réception d'une impulsion de déclenchement.

Le sélecteur de déclenchement de la base de temps retardée présente les mêmes possibilités que le sélecteur de la base de temps principale sauf pour le déclenchement secteur et externe.
La commande LEVEL/SLOPE a la même fonction que décrite pour la base de temps principale.

Le temps de balayage de la partie intensifiée du balayage de base de temps principale dépend de la position du bouton TIME/DIV de la base de temps retardée.
Le bouton central permet d'ajuster le temps de balayage entre les échelons. Pour les mesures de temps, ce bouton doit toujours être en position CAL.

Si le bouton DEL'D TB du sélecteur de déviation horizontale est enfoncé, la partie intensifiée du balayage de base de temps principale est représentée sur l'écran tout entier.

3.Service manual

3.1. DESCRIPTION OF THE BLOCK DIAGRAM (Fig. 3.4.)

The PM 3244 block diagram will be explained briefly so far as it differs from the PM 3240 block diagram.

3.1.1. Vertical channels

Each of the four channels A, B, C and D has an input ATTENUATOR and an AMPLIFIER. All four amplifiers have a normal/invert function. The block, CHANNEL SELECTION LOGIC, drives a 4-way CHANNEL SELECTOR. The output of this selector is connected to the same delay line and final Y amplifier blocks as are used in the PM 3240 to drive the vertical deflection plates of the CRT.
Moreover, this output drives the COMPOSITE TRIGGER AMPLIFIER in order to make composite triggering possible.
The CHANNEL SELECTOR LOGIC is operated by six independent pushbuttons, which enable the selection of the display modes A, A+B added, B, C, C+D added, and D. This CHANNEL SELECTOR LOGIC block receives pulses from the CHOPPER GENERATOR, controlled by the pushbuttons chopped and alternate.

3.1.2. Horizontal channels

The TRIGGER SOURCE SELECTOR enables the choice of the following MTB trigger sources: channel A, B, C and D, the composite trigger amplifier, mains and external input.
For the DTB the following sources can be selected: channel A, B, C and D and the composite trigger amplifier.
Unlike the PM 3240, the selector does not have any facility for HF/LF trigger coupling. The trigger signal is DC-coupled.

3.2. CIRCUIT DESCRIPTION

The schematic diagram is explained as far as it differs from the PM 3240 diagram.

3.2.1. Intermediate amplifier (Fig. 3.5. and 3.6.)

As the four channels of the intermediate amplifier are identical, only channel A is described.
In the PM 3244 the trigger signal is derived from IC 401 (for channel A) via transistors TS379 and TS376, which are thermally coupled to reduce drift. Transistor TS377 is the adjustable current source for this amplifier stage. The use of this adjustment is explained later.
In the PM 3240 the trigger signal is derived from IC302 (for channel A), which also contains the channel selector.
Therefore, in the chopped mode, there is a possibility of crosstalk of the chopper signal in the trigger circuits. To minimise this, the pick off point has been changed in the PM 3244.
Because of this different pick-off point, the amplification of the trigger amplifier in the PM 3244 must be higher than that of the PM 3240. The symmetrical amplifier stage of TS379/TS376 is connected to an asymmetrical stage, TS378.
The collector of this transistor feeds the trigger source selector, which is discussed in section 3.2.6. Diode GR401 compensates for changes in the base emitter voltage of TS378 due to changes of ambient temperature.

Each of the four channels has a normal/invert switch, which controls the normal/invert circuit via one wire.
In channel A, the normal/invert function is achieved with TS413, TS412, TS411 and TS409. The bases of TS409 and TS413 are held at a fixed voltage level determined by voltage divider R464 and R466.
The bases of the two other transistors are connected to voltage divider R461, R465 and R463. Dependent on the position of SK20A, this divider provides two fixed voltages. In the normal position the potential on the base of TS413 and TS409 exceeds the potential on the base of the other two transistors. The signal is now routed via TS413 and TS409. In the invert position, the potential on the base of TS412 and TS411 is higher and the signal is routed via these transistors and inversion takes place.

The signal for composite triggering is picked off after the channel selector (Fig. 3.6.) by means of a symmetrical amplifier stage comprising transistors TS506, TS508, which are thermally coupled to reduce drift, and adjustable current source TS507.

The use of this adjustment is explained later. The amplifier stage, TS506 and TS508, feeds the asymmetrical stage, TS509.
The collector of this transistor feeds the trigger source selector. Diode GR501 compensates for changes in the base emitter voltage of TS509, due to changes of ambient temperature.

A small modification of the composite trigger pick-off amplifier enables AC coupling of the compositie triggering. This modification is explained in section 3.2.2.

3.2.2. Modification for AC Coupling of Composite Triggering

The standard trigger bandwidth of the PM 3244 is d.c. ... 50 MHz. When two or more different signals are displayed with composite triggering, the displayed waveforms will partly overlap each other due to the fact that the trigger gap of the signals coincide.

The following modification enables the d.c. component of the composite trigger signal to be blocked with a capacitor. As a result of this, different signals can be displayed on the screen without overlapping each other.
The basic composite trigger circuit and the modified circuit are indicated in Fig. 3.7 and Fig. 3.8.
The lower cut-off frequency of the composite trigger signal depends on the value of the blocking capacitor.
A low-value capacitor will give bad triggering on low frequencies but good separation on the display.
A capacitor with a higher value will give good composite triggering on lower frequencies but will allow only a small distance between the displayed waveforms on the screen.

The relation between the value of the capacitor and the cut-off frequency is indicated in the following table.
The working voltage of this capacitor must be at least 16 V.

C_X	Cross-over frequency comp. trig.
10 μF*	5 Hz
100 nF	500 Hz
10 nF	5 kHz
3.3 nF	15 kHz

* If an electrolytic capacitor is used, connect the "+" of this capacitor to diode GR501.

The circuit to modify, is located on the intermediate amplifier board. Figure 3.9. gives the component layout after the modification.

Required parts:

– Capacitor C_X, refer to table.	
– Preset potentiometer 2.2 kohm linear	5322 101 14008
– Resistor 511 ohm, MR25	5322 116 54525
– Resistor 2,26 kohm, MR25	5322 116 50675
– Resistor 4,42 kohm, MR25	5322 116 50556

Proceed as follows:
Refer to Fig. 3.14 for the basic component lay-out of the intermediate amplifier.
- Remove R529 (10,2 kohm)
- Replace potentiometer R531 (47 kohm) by a 2,2 kohm type.
- Replace R538 (1,27 kohm) by a 511 ohm resistor.
- Unsolder the anode of GR501 from the p.c. board.
  Connect the additional capacitor (C_X) between both separated points.
- Connect a 4,42 kohm resistor between the connection C_X/anode of GR501, and the +12 V.
- Connect a 2,26 kohm resistor between the slider contact of R531 and the collector of TS509.
- The adjustment procedure of potentiometer R531 is the same as in the basic circuit. In the EXT X DEFL mode with no input signals, the spot must be in the centre of the screen; refer also to section 3.4.5. "Trigger balance adjustment".

3.2.3. Introduction – Channel Selection Logic

The circuit is located on a separate printed-circuit board and is built up with Low-Power Schottky TTL circuits.
The block diagram of the logic (Fig. 3.10) indicates that there are four outputs that drive the channel switches in the vertical intermediate amplifiers of the four channels. A channel is switched on if the relevant logic output is "high", and switched off when "low".
In this circuit description "high" is defined as a voltage level between 2 and 5 V; "low", a voltage level between 0 and 0,8 V.

The heart of the channel selection logic is formed by six D-type flip-flops, which are connected in cascade. They are housed in three integrated circuits, type SN74LS74N, indicated IC206, 209 and 214 on the schematic diagram (Fig. 3.11). A brief explanation of their operation is as follows:
Every flip-flop has two outputs: Q (pin 5 or 9) and the inverse of Q (pin 6 or 8). The information applied to the D (= data) input (pin 2 or 12) is transferred to output Q on the positive transition of the clock input (pin 3 or 11). The flip-flop is set in the case where Q is high, and therefore contains a "1". The flip-flop is reset in the case where Q is low, and contains a "0". The clear input (pin 1 or 13) is active when low and makes Q low independently of the clock or D input signal. The preset input is not used and is connected to +5 V.

The row of the six flip-flops represents the six modes: channel A, channel A and B added, channel B, channel C, channel C and D added, channel D. For identification, these flip-flops are marked in the block diagram FFa, FFa+b, FFb, FFc, FFc+d, FFd. All flip-flops receive the same clock-pulses. The flip-flops can be selected with the corresponding display mode switches SK12B ... SK17B. As these switches function independently, any display combination is possible. When one channel is selected, the corresponding flip-flop is continuously set. When more channels are selected, the "1" jumps-on every positive clock transistion of the clock inputs, to the next selected flip-flop in the row. From the last selected flip-flop the "1" jumps to the first selected flip-flop in the row. The channel selection logic has provisions to eliminate errors such as an unwanted set or reset of a flip-flop due to interference.

3.2.4. Block Diagram Description — Channel Selection Logic

The flip-flops can be selected with SK12B ... SK17B. Except for SK12B, these switches produce directly in their OFF position a "clear" command to the associated flip-flops so that their inverse output is high. The clear for FFa is given by the block CLEAR CIRCUIT FFa. The six inputs of this block are connected with the display mode switches SK12B ... SK17B.
This block only produces a clear signal for FFa if SK12B is in the OFF position and at least one of the other switches SK13B ... SK17B is in the ON position. This provision activates channel A if none of the display mode switches is depressed.

The six flip-flops are connected in cascade. The D inputs of FF (a+b) ... FFd are connected to the inverse outputs of the preceding flip-flops via five identical blocks SET/PRESET FF(a+b) ... SET/RESET FFd. The function of such a block is explained for the block SET/RESET FFc for the two possible situations:

a. The preceeding FFb is not selected (SK 14B closed): the signal on the D input of FFb is routed to the D input of FFc.
b. The preceding FFb is selected (SK14B open): the signal on the D input of FFb is not routed to the D input of FFc. The signal on the D input of FFc now depends on the condition of FFb. If FFb is set, the D input of FFc is high and if FFb is reset the D input of FFc is low.

Because of this provision the "1" jumps-on every positive clock transition, to the next selected flip-flop in the row.

From the last selected flip-flop the "1" jumps to the first selected flip-flop in the row by means of the block SET/RESET FFa. As this block incorporates the elimination of errors facility it is rather complex.

It has twelve inputs that are connected to:

a. The output of FFa
b. The inverse outputs of FF (a+b), FFb, FFc, FF (c+d).
c. SK 13B ... SK 17B and the inverse of SK13B . . . SK16B.

The block generates a high output signal in order to set FFa under the following conditions:

a. At the end of a cycle when the last selected flip-flop in the row will be reset at the next positive clock transition to appear.
b. In the case where a flip-flop is reset by unwanted interference signals: i.e. if a "1" is lost.
c. In the case where more than one flip-flop in the selected row has been set due to interference and the "1" will leave the last selected at the next clock-pulse.

Because of the above-mentioned provisions a potential error has been eliminated when the first selected flip-flop is set at the start of a new cycle.

The inverse outputs of the six flip-flops control the channels via four 2-input Nand gates. These Nand gates are designated CH. A, CH. B, CH. C and CH. D after the channels they control.
When FFa, FFb, FFc or FFd is set, one input of the relevant Nand gate becomes low; so its output becomes high and respectively switches channel A, B, C or D on.
When FF(a+b) or FF(c+d) is set, two Nand gate outputs become high together to achieve the addition of two channels.

The clock inputs of the six flip-flops are connected to the output of the CLOCK PULSE SELECTOR. Depending on the position of the chopped/alternate switch SK18A, this block selects either the output signal of the CHOPPER OSCILLATOR or the output signal of the block ALTERNATE PULSE ON/OFF. Moreover, in the chopped mode, the selector sends the inverted clock-pulses to the input of the BLANKING PULSE SHAPER. This block now generates a positive blanking pulse during the low-to-high transition of the clock inputs of the flip-flops, so that during the switching from one channel to another the display is blanked. The CHOPPER OSCILLATOR produces a square-wave of about 2 MHz if SK201 is open and 0,5 MHz if SK201 is closed. The oscillator is switched off by means of SK18A in the alternate mode. Present from /03 version: older versions have a fixed 2 MHz frequency.

Both the blocks CHOPPER OSCILLATOR and ALTERNATE PULSE ON/OFF can be switched off by the block CLOCK PULSE ON/OFF. The output depends on the inputs as follows:

a. Six inputs are connected to SK12A ... SK17A. As indicated in the block diagram these contacts are operated by the same front-panel push-buttons as SK12B ... SK17B. If more than one channel is selected, more than one input is connected to earth and the output becomes high, so that the clock-pulses are switched on.
b. Four inputs are connected to the outputs of the Nand gates that drive the channel switches in the vertical intermediate amplifiers. If none of the flip-flops is set, no channel is selected and the four inputs are low. If in this situation only 1 channel has been selected, the situation remains unless clock-pulses are applied to the flip-flops in order to set the selected flip-flop.
So if all four inputs are low the clock-pulses are switched on. They are switched off if one input becomes high because the selected flip-flop has been set.

As discussed, the chopper oscillator and alternate pulses are switched off if they are not needed. This is done to limit transmission of interference caused by these signals.

3.2.5. Circuit Description – Channel Selection Logic (Fig. 3.11)

This circuit description explains how the various blocks work and outlines their contents in relation to the schematic diagram.

Test hint

When troubleshooting it may be easy in some cases to observe the change of voltage levels on certain gates and flip-flops after each clock-pulse. This can be done by using the instrument in alternate and single-shot mode. Every time the single-shot control is operated a clock-pulse is generated at the end of the MTB sweep (MTB triggered by mains unit).

Clear Circuit FFa

The "clear" signal for FFa is made by TS203, Nor gate IC217/8,9,10 and inverter IC203/3,4.
Transistor TS203 has a high collector voltage if the display mode switches SK13B ... SK17B are in the off position so that this transistor does not receive any base current.

SET/RESET FF(a+b) ... SET/RESET FFd: every block contains two Nand gates; as there are five identical blocks, ten Nand gates are needed. These Nand gates are located in the circuit diagram just above the row of six flip-flops. The block SET/RESET FFc, which is built up with the Nand gates IC207/9,10,8 and IC211/4,5,6 operates as follows:

a. With SK14B in the off position (closed) both Nand gates function as an inverter and the voltage level on the D input of FFb is fed through to the D input of FFc.
b. With SK14B in the on position (open) output 8 of IC207 is high. Now IC211/4,5,6 inverts the inverse output of FFb. Consequently, if FFb is set, output 6 of IC211 is high and if FFb is reset, output 6 of IC211 is low.

SET/RESET FFa

The heart of this circuit is formed by five Nand gates of the open collector type with one common collector load resistor R203. These Nand gates form a so-called wire Or, which makes the D input signal for FFa. The Nand gates, which are marked RN (= resistor not), are IC208/1,2,3, IC208/4,5,6, IC208/9,10,8, IC208/12,13,11 and IC213/9,10,8.
The output of this wired-Or is only high if the output of all separate Nand gates are high. One input of each Nand gate is directly controlled by one of the switches SK13B ... SK17B.
The remaining input of IC208/1,2,3 is controlled by the output of FFa. The remaining other four inputs are controlled by two Nand gates each. They are located on the schematic diagram just below the five open collector Nand gates.

The conditions under which the output of the block SET/RESET FFa becomes high, have already been detailed in the block diagram description.

Chopper oscillator

The Nand gates IC202/1,2,3 and IC202/4,5,6 form the chopper oscillator because of the RC feedback circuit with R201, R202, C201, C202 and C200. Capacitor C200 can be connected in parallel with C202 by means of SK201. The oscillator frequency is 2 MHz (SK201 open) or 0,5 MHz (SK201 closed). Described as present from /03 version. Older versions: C200 and SK201 not present.
The oscillator can be switched off by applying a low level to input 2 of IC202 (in alternate mode) or to input 5 of IC202 (in single channel mode).

Alternate pulse ON/OFF

This block is formed by Nand gate IC201/4,5,6. The alternate pulse which is low during the MTB hold-off period is applied to input 4 of IC201. The pulse can be blocked by applying a low level to input 2 of IC201 (in single channel mode).

Clock pulse selector

This block contains three Nand gates IC202/12,13,11, IC201/1,2,3 and IC201/12,13,11.
In the chopped mode, a low level is applied to input 1 of IC201 so that alternate pulses are blocked. Output 11 of IC201 sends chopper pulses to the clock inputs of the flip-flops. In the alternate mode a low level is applied to input 13 of IC202 so that chopper pulses are blocked. Output 11 of IC201 sends alternate pulses to the clock inputs of the flip-flops.

Blanking pulse shaper

Transistor TS202 and matched components form this block.
The transistor normally conducts and its collector voltage is therefore low. Via R204 and C204, TS202 receives a negative pulse on its base during the low-to-high transition of the clock pulse. Now this transistor is non-conductive for a period determined by R204 and C204 and its collector voltage is high. Present from /03 version.
Older versions: pulse shaper contains 2 capacitor coupled amplifier stages. The input of this pulse sharper is connected to output 6 of IC202.

Clock pulse ON/OFF

This circuit is located in the lower left hand corner of the schematic diagram. When two or more channels (SK12A ... SK17A) are selected (switches closed) the base of transistor TS204 is so low that it is blocked. Its collector then becomes high. This collector signal is inverted by means of IC217/11,12,13. Resistors R233 ... R239 are located on the switch unit SK12A ... SK17A (see Fig. 3.20).
The output of this Nand gate is low if two or more channels are switched on, and causes output 8 of Nand gate IC201 to be high. If this output is high clock-pulses are applied to the flip-flops.

Independent of the number of chosen display modes, there is another command which switches the clock-pulses on. This command is made by the Nor gates IC217/5,6,4 and IC217/2,3,1 and the Nand gate IC213/12,13,11. It becomes active if all outputs of the channel selection logic are low (if all flip-flops are reset). In this case output 11 of IC213 is low, and the clock-pulses are switched on.

The logic circuit draws more current in the chopped mode than in the alternate mode. This difference could cause unwanted drift in other parts of the instrument. The trimming potentiometer R220 and R215 between +5 V and contact 3 of SK18A (chopped/alternate switch) compensate for this difference.
R220 must be adjusted to maximum chopped/alternate balance. Present from /03 version: older versions do not have this compensation.

3.2.6. Trigger Source Selector (Fig. 3.12)

This unit switches the triggering signal from the desired source through to the MTB and DTB trigger amplifiers. These sources are the trigger pick-off amplifiers of the channels A, B, C, D and composite in the intermediate amplifier, the external input amplifier and the mains trigger amplifier. These are selected by SK21 for the MTB and SK10 for the DTB. The signals from the four channels and the composite signal are fed to five identical input circuits, The circuit explanation is given for channel A only.

The current from the pick-off amplifier in channel A is equally divided between the emitters of TS751 and TS752. Resistors R751 and R754 make the current division more independent of the emitter base voltages of TS751 and TS752,

Transistor TS751 is able to pass its collector signal to the base of TS704 if the diodes GR751 and GR753 conduct. These diodes conduct if their cathodes are connected via R753 and SK21 to −12 V. Diode GR752 does not conduct in this situation. The base of TS704 is held at −6 V by means of GR709 and R727. The collector signal of TS704 is applied to the MTB trigger amplifier by means of emitter-follower TS706. The output voltage of this emitter-follower is adjusted to earth potential by means of the adjustable current sources in the pick-off amplifiers.
If the cathodes of GR751 and GR753 are floating because SK21 does not apply R753 to any potential, the collector current flows through GR752 and the triggering signal of channel A does not reach the MTB trigger amplifier.

The circuit comprising TS752 is able to pass its collector signal to the base of TS707 in order to trigger the DTB. This happens if GR754 and GR757 are made conductive by applying their cathodes to −12 V via R757 and SK10. The signal on the collector of TS707 is applied to the DTB trigger amplifier by means of emitter-follower TS708. The output voltage of this transistor is not separately adjustable to earth potential as described for TS706.

The signal on the external input (BU4) is applied to the base of emitter-follower TS701 via a voltage dividing network. This transistor is followed by TS702, which gives base current to TS704 if GR703 and GR704 conduct. These diodes conduct if their cathodes are applied to −12 V by means of R714, R705 and SK21. Resistor R705 permits adjustment of the output voltage of TS706. Diode GR702 conducts if GR703 and GR704 are non-conductive.

The signal from the mains trigger unit on the power supply reaches the base of TS703. The collector signal of this transistor is applied to the base of TS704 if GR707 and GR708 are conducting. These diodes conduct if their cathodes are connected to −12 V via TS705 and R720.
This occurs if TS705 receives base current via R719 and R715, which is connected to earth via SK21. Because of a limitation of SK21, only an earth potential command for mains triggering is available and it is converted by means of TS705 into a −12 V command. Switch SK21 gives −12 V to R773 in the mains trigger mode (SK21B and SK21C both depressed). Diode GR771 becomes conductive in this situation and channel C is not switched on.

The DTB trigger pulses are blocked in the STARTS mode, when they are not needed. This is done by applying −12 V to R735, which is otherwise floating. Moreover, contact 10 A/2 is now floating; this contact is otherwise connected to −12 V.

The +6 V supply for the trigger source selector is stabilised by means of TS709, GR712 and GR713. The changes in voltage due to variations of ambient temperature of these semiconductors compensate each other. This stabilisation prevents crosstalk of unselected trigger signals via the internal resistance of the power supply.

3.3. DISMANTLING THE INSTRUMENT

In addition to the procedures described in the PM 3240 manual, the removal of the trigger source selector p.c.b. and some pushbutton switch units is explained.

3.3.1. Removal of Trigger Source Selector

1. Remove the bottom cover plate.
2. Remove shaft and knob from hold-off potentiometer by removing coupling piece.
3. Unsolder six leads and one coaxial cable from underside of p.c.b.
4. Loosen screw in front plate and screws in hold-off potentiometer support. When re-assembling this support remember to connect solder tag of hold-off potentiometer cable screening to earth.
5. Remove the top cover plate.
6. Remove shaft and knob from POSITION potentiometer by removing coupling piece.
7. Remove support of POSITION potentiometer by means of two screws.
8. Unsolder six leads and five coaxial cables from top-side of p.c.b.
9. Loosen hexagonal front-panel screw and clamping piece.

3.3.2. Removal of the Pushbutton Units: SK8, SK9 and SK11 ... SK18

First remove the top cover plate for access to these switch units. As these switch units and the DELAY TIME multiplier are interconnected by means of several wires, care should be taken when removing these controls to ensure that these interconnections are not damaged.

1. Unscrew, with the tool indicated in Fig. 3.8 of the PM 3240 manual, two screws in the front plate in order to release the mounting piece of the LEVEL potentiometers.
2. Remove the DELAY TIME multiplier.
3. Remove the SK8, SK9 unit by unscrewing two hexagonal screws and removing two clamping pieces. In this situation it is also possible to remove the NOT TRIG'D LED indicator GR1.
4. Remove knobs from MTB and DTB switches.
5. Remove MTB and DTB switch units (unplug attached Stocko plugs on time base p.c.b).
6. Remove the SK11 ... SK18 unit by unscrewing four hexagonal screws and removing four clamping pieces.

3.4. ADJUSTING PROCEDURE

In addition to the adjusting procedure in the basic PM 3240 manual, the following adjustments can be carried out. For adjustment points see Fig. 3.17 and 3.18.

3.4.1. Normal/Invert Balance

- Depress buttons A, B, C, D of the vertical display switch.
- Adjust the following potentiometers so that the corresponding trace does not jump when the 'PULL TO INVERT' switch is operated.
  ch. A : R448
  ch. B : R2648
  ch. C : R2848
  ch. D : R2448
  These potentiometers are located on the intermediate amplifier unit.

3.4.2. A+B Balance

- Depress buttons A, A+B and B of the vertical display switch.
- Shift the three traces so that they are superimposed on each other, using the ch. A and ch. B POSITION controls on the front panel.
- Adjust potentiometer R548 (located on the intermediate amplifier unit) so that the trace is on the horizontal centre-line of the graticule.

The C+D balance is now also correct.

3.4.3. Chopped/Alternate Balance (present from /03 version)

Adjust R220 on the channel selection unit so that the voltage on R212 does not change when switching between chopped and alternate mode. Measure the voltage on R212 with a sensitive instrument; e.g. an oscilloscope.

3.4.4. Chopper Frequency Adjustment (present from /03 version)

A display of 0,5 μs or 2 μs can be selected with the miniature slider switch SK201 on the channel selection unit.
The 0,5 μs position gives high resolution at fast single-shot displays.
The 2 μs position gives increased brightness at high sweep speeds.

3.4.5. Trigger Balance

- Depress pushbutton A of the vertical display switch.
- Depress pushbutton MAIN TB of the horizontal display switch.
- Set TB MAGN. to x1 position.
- Depress pushbutton AUTO of the main timebase mode switch.
- Set main timebase sweep to 0,5 ms/DIV.
- Depress pushbutton A of the main timebase trigger source switch.
- Set input coupling switches of all vertical deflection channels in position D.
- Adjust horizontal POSITION control on the front panel so that the trace starts at the extreme left-hand graticule line.
- Adjust channel A POSITION so that the trace is on the horizontal centre graticule line.
- Depress button EXT X DEFL of the horizontal display switch.
- Adjust potentiometer R379 (intermediate amplifier unit) so that the spot is in the centre of the graticule.
- Depress pushbutton B of the main timebase trigger source switch.
- Adjust potentiometer R2579 (intermediate amplifier unit) so that the spot is in the centre.
- Depress pushbutton C of the main timebase trigger source switch.

- Adjust potentiometer R2779 (intermediate amplifier unit) so that the spot is in the centre.
- Depress pushbutton D of the main timebase trigger source switch.
- Adjust potentiometer R2379 (intermediate amplifier unit) so that the spot is in the centre.
- Depress both pushbuttons A and B (for comp.) of the main timebase trigger source switch.
- Adjust potentiometer R531 (trigger source selector unit) so that the spot is in the centre.
- Depress both C and D pushbuttons (for EXT) of the main timebase trigger source switch.
- Adjust potentiometer R705 (trigger source selector unit) so that the spot is in the centre.
- Depress both B and C pushbuttons (for LINE) of the main timebase trigger source switch.
- Select the value for R715 (7,15 ... 9,53 kohms) so that mains deflection is symmetrical around the centre of the graticule.

3.4.6. Delay-Time Calibration

(Start- and stop-potentiometers R987 and R979 are located on the small p.c. board underneath the c.r.t.)

- Set the delayed timebase sweep to .1 ms/DIV.
- Set the main timebase sweep to 1 ms/DIV.
- Depress pushbutton MAIN TB of the horizontal display switch.
- Depress pushbutton STARTS of the delayed timebase mode switch.
- Depress pushbutton A of the vertical display switch.
- Depress pushbutton A of the main timebase trigger source switch.
- Apply a 1 ms squarewave signal to the channel A input.
- Set the DELAY TIME multiplier dial knob to 1,00.
- Adjust 'start' potentiometer R987 (front-panel side) so that the beginning of the intensified part of the trace coincides with the beginning of the 2nd period.
- Set the DELAY TIME multiplier dial knob to 9,00.
- Adjust 'stop' potentiometer R979 so that the beginning of the intensified part of the trace coincides with the beginning of the 9th period.
- Repeat both adjustments for optimum results.

3.4.7. Attenuator adjustment

The /02 and /03 versions have been equipped with different attenuators, that are however mechanically interchangeable. The input capacitance and 10 kHz square wave compensation are equivalent for both types of attenuators.
Adjustment points that are different for both types are discussed briefly. These points are located on the bottom side of the unit.

/02 version

Variable Gain Balance (R128)

- Centre the timebase line, using the POSITION control.
- Adjust R128 (output DC offset compensation) to minimal timebase line jump when operating the CONT Gain Control.

/03 version (see Fig. 3.18)

LF Gain Adjustment (R132)

Besides the adjustment points in the intermediate amplifier the attenuators have a LF GAIN adjustment point R132. To be sure that the attenuator unit is well adjusted connect an oscilloscope to its output. Apply a 100 Hz square wave signal to the input of the unit and adjust R132 if necessary. The attenuator has in the 5 mV/div. position an attenuation of 1,25x.
The attenuator output must have its normal load of approx. 50 ohms; for instance the intermediate amplifier.

DC/0 Balance (R129)

- Put R141 (output DC offset compensation) in its mid position.
- Set the AMPL/DIV switch to 5 mV/div.
- Depress alternately the DC and 0 coupling switches and adjust R129 to minimal time base line jump.

Variable Gain Balance (R141)

Identical to adjustment procedure of R128 in /02 version.

100 kHz Square-wave Response Adjustment (C122)

Besides the 100 kHz adjustment points in the intermediate amplifier the attenuators have a 100 kHz adjustment trimmer C122. This trimmer works on all attenuator positions. To be sure that the attenuator unit is well adjusted connect an oscilloscope with a bandwidth of 50 MHz or more to the output of the attenuator and set C122 to maximum square wave response. The attenuator output must have its normal load of approx. 50 ohms (for instance the intermediate amplifier). The attenuator has in the 5 mV/div position an attenuation of 1,25x.

3.5. PARTS LISTS

3.5.1. Mechanical parts list (addition to PM 3240 list)

Item	*Ordering code*	*Description*
–	5322 459 84021	Inner plate of front cover box
–	5322 455 84064	Text plate PM 3244
–	5322 459 24071	Cast alluminium front profile

3.5.2. Various parts

Ordering code	*Description*
5322 320 44033	Delay line
5322 277 24053	Slider switch SK201 logic unit
5322 216 64258	Time base unit
5322 216 64259	Delay time calibration unit
5322 414 34147	Ten turn dial
5322 216 54116	Power supply unit
5322 218 64045	Mains filter
5322 216 64257	Transistor unit TS1804 (BD232)
5322 462 54138	C.R.T. shield

3.5.3. Unit list (addition to PM 3240 list)

Item	*Ordering code*	*Description*
Unit 2	5322 105 44001	Attenuator
Unit 12	5322 216 64261	Intermediate amplifier unit
Unit 14	5322 216 64263	Channel selection logic unit
Unit 16	5322 216 64262	Trigger source selector unit

3.5.4. Electrical parts lists (Complete)

Transistors

Type	*Ordering code*	*Remark*	*Encapsulation*	*Quantity in one set*
BC327	4822 130 40854		T0-92	1
BC547	5322 130 44257		T0-92	1
BC549	4822 130 40964		T0-92	76
BC549C	5322 130 44246		T0-92	8
BC557	5322 130 44256		T0-92	1
BC559	4822 130 40963		T0-92	19
BC559B	5322 130 44358		T0-92	1
BCY71	5322 130 40373		T0-18	2
BD136	5322 130 40712		T0-126	3
BD137	5322 130 40664		T0-126	1
BD262	5322 130 44357		T0-126	1
BDY93/01	5322 130 44105		T0-3	1
BF199	5322 130 44154		T0-96	14
BF324	5322 130 44396		T0-96	27
BF336	4822 130 40908		T0-39	2
BFS17	5322 130 40781	Mark: E1	SOT-23	7
BFS17R	5322 130 44338	Mark: E4	SOT-23	5
BFW44	5322 130 40672		T0-39	2
BFY90	5322 130 40493		T0-72	9
BRY39	5322 130 40482	Thyristor	T0-72	1

Type	*Ordering code*	*Remark*	*Encapsulation*	*Quantity in one set*
BSW68	5322 130 40714		T0-39	1
BSX20	5322 130 40417		T0-18	5
BSX21	5322 130 40321		T0-18	4
BSX60	5322 130 44019		T0-39	1
CNY43	5322 130 44395	Photocoupler	S0T-91B	1
FW5324	5322 130 40142		T0-18	2
FW5497	5322 130 40673		T0-18	2
2N2894	5322 130 40018		T0-18	3
2N2894A	5322 130 44127		T0-18	1
537-BSY	5322 130 44359	Mark: B3	S0T-23	1
BFT25R	5322 130 44459	Mark: V4	SOT-23	4
BFR92R	5322 130 44606	Mark: P4	SOT-23	4
ON471	5322 130 44605	Mark: M3	SOT-23	4

Integrated circuits

Type	*Ordering code*	*Remark*	*Encapsulation*	*Quantity in one set*
SN74LS00N	5322 209 84983	Quad 2 input nand gate	14 PIN DIL	7
SN74LS02N	5322 209 84993	Quad 2 input nor gate	14 PIN DIL	1
SN74LS03N	5322 209 85265	Quad 2 input nand gate	14 PIN DIL	2
SN74LS04N	5322 209 84984	Hex inverter	14 PIN DIL	1
SN74LS74N	5322 209 84986	Dual D flip-flop	14 PIN DIL	3
4022 105 25160	5322 209 84424	Impedance converter		4
OQ002	5322 209 84355	Transistor-diode array	S0T-43	11
TAA521/709HC	5322 209 84452	Operational amplifier	T0-99	1
TBA281/LM723CH	5322 209 84899	Voltage regulator	TO-100	1
LM208T	5322 209 85475	Precision Op Amp	TO-99	4
4022 105 25430	5322 111 94032	TF circuit	—	4

Diodes

Type	*Ordering code*	*Remark*	*Encapsulation*	*Quantity in one set*
BA182	5322 130 30644		S0D-23	2
BAV45	5322 130 34037		T0-18	4
BAW62	5322 130 30613		D0-35	90
BAX12	5322 130 30424		S0D-17	14
BAX17	5322 130 30605		S0D-17	6
BY206	4822 130 30839		D0-14	9
BYX10	5322 130 30195		D0-14	1
BYX55/600	4822 130 30817		S0D-18	1
CQY24A	5322 130 34595	LED	—	2
BY179	5322 130 30521	Bridge rectifier	S0D-28	1
BY409	5322 130 34594		S0D-34	6
AAZ15	5322 130 30229	Germanium diode	D0-7	2
BR100	4822 130 20039	Trigger device	D0-14	1

Voltage reference diodes

Type	*Ordering code*	*Remark*	*Encapsulation*	*Quantity in one set*
BZX61C13	5322 130 30771		S0D-22	1
BZX61C47	5322 130 30565		S0D-22	1
BZX61C75	5322 130 34034		S0D-22	1
BZX75C1V4	5322 130 34047		D0-7	1
BZX75C2V8	5322 130 34048		D0-7	2
BZX75C3V6	5322 130 30765		D0-7	1
BZX79C4V7	5322 130 30773		D0-35	1
BZX79C5V6	5322 130 34173		D0-35	5
BZX79C6V8	5322 130 30768		D0-35	1
BZX79B7V5	4822 130 30861		D0-35	2
BZX79B8V2	5322 130 34382		D0-35	2
BZX79B9V1	5322 130 30667		D0-35	1
BZX79C9V1	5322 130 30667		D0-35	1
BZX79C10	5322 130 34297		D0-35	2
BZX79C47	5322 130 34383		D0-35	1
BZX79B62	5322 130 34384		D0-35	2
BZY88C3V3	5322 130 30392		D0-7	1

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
CAPACITORS					
C 101	5322 125 64009	3pF		500	TRIMMER
C 102	5322 125 64015	4,5pF		500	TRIMMER
C 103	5322 123 34001	30PF	10	300	MICA
C 104	4822 121 40278	22NF	10	400	POLYESTER FOIL
C 105	4822 122 31041	3,3PF	0,25PF	100	CERAMIC PLATE
C 106	4822 122 31203	39PF	2	500	CERAMIC PLATE
C 107	5322 125 64012	1,5PF		500	TRIMMER
C 108	5322 125 64014	3PF		500	TRIMMER
C 109	5322 125 64009	3PF		500	TRIMMER
C 111	5322 125 64015	4,5pF		500	TRIMMER
C 112	5322 123 10168	300PF	10	300	MICA
C 113	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 114	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 115	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 116	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 117	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 118	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 119	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 121	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 201	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 202	4822 122 30135	820PF	10	100	CERAMIC PLATE
C 203	4822 122 30053	680PF	10	100	CERAMIC PLATE
C 204	4822 122 31085	150PF	2	100	CERAMIC PLATE
C 205	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 206	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 208	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 209	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 211	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 212	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 213	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 214	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 216	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 217	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 218	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 376	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 377	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 379	4822 122 30048	1,8NF	10	100	CERAMIC PLATE
C 381	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 382	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 401	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 402	4822 125 50045	22pF		100	TRIMMER
C 403	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 404	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 405	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 406	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 407	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 408	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 409	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 410	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 412	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 413	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 415	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 416	4822 125 50045	22pF		100	TRIMMER
C 417	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 420	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 423	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 424	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 425	4822 122 30099	3,3NF	10	100	CERAMIC PLATE
C 426	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 427	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 428	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 429	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 432	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 501	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 504	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 506	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 507	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 508	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 509	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 511	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 514	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 516	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 517	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 518	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 521	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 522	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 523	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 524	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 526	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 527	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 531	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 532	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 533	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 534	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 536	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 537	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 601	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 602	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 603	4822 125 50045	22pF		100	TRIMMER
C 604	4822 122 31074	56PF	2	100	CERAMIC PLATE
C 605	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 606	4822 125 50045	22pF		100	TRIMMER
C 607	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 608	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 609	4822 122 31116	2,2NF	10	100	CERAMIC PLATE
C 614	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 616	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 618	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 619	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 621	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 622	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 623	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 626	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 627	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 628	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 629	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 631	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 632	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 633	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 634	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 651	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 652	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 653	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 701	4822 122 31202	33PF	2	500	CERAMIC PLATE
C 703	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 704	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 705	4822 122 31195	10PF	2	500	CERAMIC PLATE
C 706	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 707	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 708	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 709	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 711	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 712	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 713	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 714	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 715	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 716	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 717	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 751	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 752	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 761	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 762	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 771	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 772	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 781	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 782	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 791	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 792	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 801	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 802	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 803	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 804	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 805	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 806	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 807	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 808	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 809	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 850	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 851	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 852	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 853	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 854	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 855	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 856	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 857	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 858	4822 124 20483	6,8UF	-10+50	40	ELECTROLYTIC
C 859	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 860	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 861	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 862	4822 122 30114	2,2NF	10	100	CERAMIC PLATE
C 863	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 864	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 866	5322 121 54076	453PF	1	250	POLYSTYRENE FOIL
C 867	5322 121 40224	4,7UF	10	100	POLYESTER FOIL
C 868	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 869	5322 121 54108	47NF	1	63	POLYSTYRENE FOIL
C 871	5322 121 14072	330NF		35	BOX
C 872	4822 122 30034	470PF	10	100	CERAMIC PLATE
C 873	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 874	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 876	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 878	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 879	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 881	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 882	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1001	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1002	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1003	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1004	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1005	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 1006	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1007	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1008	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1009	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1051	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1052	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1053	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1054	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1056	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 1057	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1058	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 1059	5322 121 54076	453PF	1	250	POLYSTYRENE FOIL
C 1060	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 1061	5322 121 54108	47NF	1	63	POLYSTYRENE FOIL
C 1062	4822 122 30034	470PF	10	100	CERAMIC PLATE
C 1063	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1064	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1066	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1067	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1068	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1069	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1201	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1202	4822 122 31215	0,68PF	0,25PF	100	CERAMIC PLATE
C 1203	4822 125 50077	5,5PF		100	TRIMMER
C 1204	4822 122 31116	2,2NF	10	500	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1205	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1206	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1207	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1208	4822 125 50077	5,5 PF		100	TRIMMER
C 1209	4822 122 31215	0,68PF	0,25PF	100	CERAMIC PLATE
C 1211	4822 122 31116	2,2NF	10	500	CERAMIC PLATE
C 1212	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1213	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1214	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1216	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1302	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1303	4822 122 30104	1PF	0,25PF	100	CERAMIC PLATE
C 1304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1306	4822 122 30054	1,2NF	10	100	CERAMIC PLATE
C 1307	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 1308	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1309	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1310	4822 121 40406	15NF	10	250	POLYESTER FOIL
C 1311	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1312	5322 122 54006	3,3NF	-20+50	3K	CERAMIC DISK
C 1313	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1314	5322 122 54006	3,3NF	-20+50	3K	CERAMIC DISK
C 1316	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1317	5322 121 40233	680NF	10	100	POLYESTER FOIL
C 1318	4822 121 50611	20NF	1	63	POLYSTYRENE FOIL
C 1319	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1401	4822 124 20497	15UF	-10+50	63	ELECTROLYTIC
C 1402	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1403	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1404	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1406	5322 122 54006	3,3NF	-20+50	3K	CERAMIC DISK
C 1407	4822 121 40363	10NF	10	1600	POLYESTER FOIL
C 1416	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1417	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1418	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1419	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1421	5322 122 54004	470PF	20	4K	CERAMIC DISK
C 1801	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1802	5322 122 44009	2,2NF	20	250	CERAMIC DISK
C 1803	5322 122 44009	2,2NF	20	250	CERAMIC DISK
C 1804	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1806	4822 124 40066	50+50 UF		400	ELECTROLYTIC
C 1807	4822 124 20324	4UF	-10+30	400	ELECTROLYTIC
C 1808	4822 124 20324	4UF	-10+30	400	ELECTROLYTIC
C 1809	4822 124 20306	50UF	-10+30	100	ELECTROLYTIC
C 1810	4822 124 20581	220UF	-10+50	4	ELECTROLYTIC
C 1811	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 1812	4822 124 20583	1UF	-10+50	63	ELECTROLYTIC
C 1814	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1816	4822 124 20461	47UF	-10+50	10	ELECTROLYTIC
C 1817	4822 121 40443	680NF	10	250	POLYESTER FOIL
C 1818	4822 121 41161	100NF	10	100	POLYESTER FOIL
C 1819	4822 122 30094	220PF	10	100	CERAMIC PLATE
C 1821	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 1822	4822 121 41161	100NF	10	100	POLYESTER FOIL
C 1823	4822 124 20587	100UF	-10+50	25	ELECTROLYTIC
C 1824	4822 121 41169	220NF	10	250	POLYESTER FOIL
C 1826	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1827	4822 124 20457	470UF	-10+50	6,3	ELECTROLYTIC
C 1828	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1829	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1830	4822 121 40298	4,7NF	10	1600	POLYESTER FOIL
C 1831	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1832	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1833	4822 124 20497	15UF	-10+50	63	ELECTROLYTIC
C 1834	4822 124 20497	15UF	-10+50	63	ELECTROLYTIC
C 1836	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1837	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1838	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1839	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1841	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1842	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1843	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1844	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1846	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1847	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1848	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1849	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 2376	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2377	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2379	4822 122 30048	1,8NF	10	100	CERAMIC PLATE
C 2381	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 2382	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2401	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2402	4822 125 50045	22PF		100	TRIMMER
C 2403	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2404	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2405	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2406	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2407	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2408	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2409	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2410	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2412	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2413	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2415	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 2416	4822 125 50045	22PF		100	TRIMMER
C 2417	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 2420	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 2423	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2424	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2425	4822 122 30099	3,3NF	10	100	CERAMIC PLATE
C 2426	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2427	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2428	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2429	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2432	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2576	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2577	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2579	4822 122 30048	1,8NF	10	100	CERAMIC PLATE
C 2580	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2581	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 2582	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2601	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2602	4822 125 50045	22PF		100	TRIMMER
C 2603	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2604	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2605	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2606	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2607	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2608	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2609	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2610	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2611	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2612	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2613	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2614	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2615	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 2616	4822 125 50045	22PF		100	TRIMMER
C 2617	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 2620	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 2623	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2625	4822 122 30099	3,3NF	10	100	CERAMIC PLATE
C 2626	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2627	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2628	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 2629	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2632	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2776	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2777	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2779	4822 122 30048	1,8NF	10	100	CERAMIC PLATE
C 2781	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 2782	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2801	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2802	4822 125 50045	22pF		100	TRIMMER
C 2803	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2804	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2805	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2806	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2807	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2808	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2809	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2810	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2811	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2812	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2813	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2814	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2815	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 2816	4822 125 50045	22pF		100	TRIMMER
C 2817	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 2820	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 2823	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2824	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2825	4822 122 30099	3,3NF	10	100	CERAMIC PLATE
C 2826	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2827	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2828	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2829	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2832	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
RESISTORS					
R 1	5322 101 44014	100K	20		CARBON POTM LIN + SWITCH
R 2	5322 103 64016	5K	5	2W	WIRE-WOUND POTENTIOMETER
R 3	5322 101 44014	100K	20		CARBON POTM LIN + SWITCH
R 4	5322 101 44015	50K	20		CARBON POTM LIN + SWITCH
R 5	5322 101 40041	4,7K	20	0,25W	CARBON POTM LIN + SWITCH
R 6	5322 101 40041	4,7K	20	0,25W	CARBON POTM LIN + SWITCH
R 7	5322 101 74005	10K	20	0,1W	CARBON POTM LOG + SWITCH
R 8	5322 101 24046	100	20	0,1W	CARBON POTM LIN
R 9	5322 101 34016	47K	20	0,1W	CARBON POTM LOG
R 10	5322 101 24108	500R	1		CARBON POTM LIN
R 11	5322 101 24091	47K	20	0,1W	CARBON POTM LIN
R 12	5322 101 24055	25K	20		CARBON POTM LIN
R 13	5322 101 34018	4,7K	20	0,1W	CARBON POTM LOG
R 14	5322 101 24062	2,2M	20	0,1W	CARBON POTM LIN
R 101	4822 111 30067	33	5	CR16	CARBON
R 102	5322 116 55021	920K	0,25		METAL FILM
R 103	5322 111 30383	68	5	CR16	CARBON
R 104	5322 116 55067	88,9K	0,25	MR24C	METAL FILM
R 106	4822 111 30245	47	5	CR16	CARBON
R 107	5322 116 54892	200K	0,25		METAL FILM
R 108	5322 116 55023	800K	0,25		METAL FILM
R 109	4822 111 30309	560	5	CR16	CARBON
R 111	4822 111 30309	560	5	CR16	CARBON
R 112	4822 111 30069	39	5	CR16	CARBON
R 113	5322 116 55022	992K	0,25		METAL FILM
R 114	5322 116 55066	8,08K	0,25	MR24C	METAL FILM
R 116	5322 111 30383	68	5	CR16	CARBON
R 118	5322 116 50592	442	1	MR25	METAL FILM
R 119	5322 116 50592	442	1	MR25	METAL FILM
R 121	4822 111 30347	10	5	CR16	CARBON
R 122	4822 111 30304	150K	5	CR16	CARBON
R 123	5322 116 54499	249	1	MR25	METAL FILM
R 124	4822 110 63038	2,7	5	CR25	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 126	4822 110 63043	3,9	5	CR25	CARBON
R 128	5322 100 10141	10K	20	0,75W	TRIMMING POTM
R 129	5322 116 50672	51,1K	1	MR25	METAL FILM
R 201	5322 116 54466	90,9	1	MR25	METAL FILM
R 202	5322 116 54466	90,9	1	MR25	METAL FILM
R 203	5322 116 54571	1,96K	1	MR25	METAL FILM
R 204	5322 116 50417	162	1	MR25	METAL FILM
R 206	5322 116 50581	2,49K	1	MR25	METAL FILM
R 207	5322 116 54513	332	1	MR25	METAL FILM
R 208	5322 116 50675	2,26K	1	MR25	METAL FILM
R 209	5322 116 50586	1,54K	1	MR25	METAL FILM
R 211	5322 116 50675	2,26K	1	MR25	METAL FILM
R 212	5322 116 50568	4,99	1	MR25	METAL FILM
R 213	5322 116 54012	6,81K	1	MR25	METAL FILM
R 214	5322 116 54012	6,81K	1	MR25	METAL FILM
R 216	5322 116 54012	6,81K	1	MR25	METAL FILM
R 217	5322 116 54012	6,81K	1	MR25	METAL FILM
R 218	5322 116 50481	22,6K	1	MR25	METAL FILM
R 219	5322 116 50556	4,42K	1	MR25	METAL FILM
R 221	5322 116 50481	22,6K	1	MR25	METAL FILM
R 222	5322 116 50556	4,42K	1	MR25	METAL FILM
R 223	5322 116 50481	22,6K	1	MR25	METAL FILM
R 224	5322 116 50556	4,42K	1	MR25	METAL FILM
R 226	5322 116 50481	22,6K	1	MR25	METAL FILM
R 227	5322 116 50556	4,42K	1	MR25	METAL FILM
R 228	5322 116 50481	22,6K	1	MR25	METAL FILM
R 229	5322 116 50556	4,42K	1	MR25	METAL FILM
R 231	5322 116 54012	6,81K	1	MR25	METAL FILM
R 232	5322 116 54619	10K	1	MR25	METAL FILM
R 233	5322 116 50664	2,05K	1	MR25	METAL FILM
R 234	5322 116 50664	2,05K	1	MR25	METAL FILM
R 236	5322 116 50664	2,05K	1	MR25	METAL FILM
R 237	5322 116 50664	2,05K	1	MR25	METAL FILM
R 238	5322 116 50664	2,05K	1	MR25	METAL FILM
R 239	5322 116 50664	2,05K	1	MR25	METAL FILM
R 241	5322 116 50556	4,42K	1	MR25	METAL FILM
R 242	5322 116 54012	6,81K	1	MR25	METAL FILM
R 376	5322 116 54012	6,81K	1	MR25	METAL FILM
R 377	5322 116 54595	5,11K	1	MR25	METAL FILM
R 378	5322 116 50558	18,7K	1	MR25	METAL FILM
R 379	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 381	5322 116 50527	33,2	1	MR25	METAL FILM
R 382	4822 111 30067	33	5	CR16	CARBON
R 383	5322 116 54557	1,21K	1	MR25	METAL FILM
R 387	5322 116 50452	10	1	MR25	METAL FILM
R 388	5322 116 54519	402	1	MR25	METAL FILM
R 389	5322 116 54469	100	1	MR25	METAL FILM
R 390	5322 116 54541	825	1	MR25	METAL FILM
R 391	5322 116 50568	4,99	1	MR25	METAL FILM
R 392	5322 116 50527	33,2	1	MR25	METAL FILM
R 393	4822 111 30324	100	5	CR16	CARBON
R 394	5322 116 54439	35,7	1	MR25	METAL FILM
R 396	5322 116 54548	976	1	MR25	METAL FILM
R 397	5322 116 54439	35,7	1	MR25	METAL FILM
R 398	4822 111 30324	100	5	CR16	CARBON
R 401	5322 116 50524	3,01K	1	MR25	METAL FILM
R 402	5322 116 54508	301	1	MR25	METAL FILM
R 403	4822 111 30067	33	5	CR16	CARBON
R 404	5322 116 50524	3,01K	1	MR25	METAL FILM
R 405	5322 116 54464	86,6	1	MR25	METAL FILM
R 406	4822 111 30347	10	5	CR16	CARBON
R 407	5322 116 50492	46,4	1	MR25	METAL FILM
R 408	5322 116 50568	4,99	1	MR25	METAL FILM
R 409	5322 116 50492	46,4	1	MR25	METAL FILM
R 410	5322 116 34036	47	5	0,5W	NTC
R 411	4822 111 30347	10	5	CR16	CARBON
R 412	4822 111 30067	33	5	CR16	CARBON
R 413	5322 116 50515	1,78K	1	MR25	METAL FILM
R 414	5322 116 54005	3,32K	1	MR25	METAL FILM
R 416	5322 116 50452	10	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 417	5322 116 50571	715	1	MR25	METAL FILM
R 418	4822 111 30245	47	5	CR16	CARBON
R 419	4822 111 30347	10	5	CR16	CARBON
R 420	5322 116 54464	86,6	1	MR25	METAL FILM
R 421	4822 111 30067	33	5	CR16	CARBON
R 422	5322 116 54492	178	1	MR25	METAL FILM
R 423	4822 111 30067	33	5	CR16	CARBON
R 424	5322 116 54576	2,37K	1	MR25	METAL FILM
R 426	5322 116 54587	3,65K	1	MR25	METAL FILM
R 427	5322 116 50527	33,2	1	MR25	METAL FILM
R 428	4822 111 30067	33	5	CR16	CARBON
R 429	5322 116 54492	178	1	MR25	METAL FILM
R 431	4822 111 30347	10	5	CR16	CARBON
R 432	5322 116 50571	715	1	MR25	METAL FILM
R 433	4822 111 30245	47	5	CR16	CARBON
R 434	5322 116 50452	10	1	MR25	METAL FILM
R 436	4822 111 30067	33	5	CR16	CARBON
R 437	5322 116 54613	8,66K	1	MR25	METAL FILM
R 438	5322 116 54005	3,32K	1	MR25	METAL FILM
R 439	4822 111 30067	33	5	CR16	CARBON
R 440	5322 116 50484	4,64K	1	MR25	METAL FILM
R 441	5322 116 50926	40,2	1	MR25	METAL FILM
R 442	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 443	5322 116 54515	348	1	MR25	METAL FILM
R 444	5322 116 50926	40,2	1	MR25	METAL FILM
R 445	5322 116 54595	5,11K	1	MR25	METAL FILM
R 446	4822 111 30067	33	5	CR16	CARBON
R 447	5322 116 50442	48,7K	1	MR25	METAL FILM
R 448	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 461	5322 116 54005	3,32K	1	MR25	METAL FILM
R 463	5322 116 54576	2,37K	1	MR25	METAL FILM
R 464	5322 116 54005	3,32K	1	MR25	METAL FILM
R 465	5322 116 54012	6,81K	1	MR25	METAL FILM
R 466	5322 116 54585	3,48K	1	MR25	METAL FILM
R 467	4822 111 30067	33	5	CR16	CARBON
R 468	4822 111 30067	33	5	CR16	CARBON
R 469	4822 111 30067	33	5	CR16	CARBON
R 471	4822 111 30067	33	5	CR16	CARBON
R 472	4822 111 30067	33	5	CR16	CARBON
R 473	4822 111 30067	33	5	CR16	CARBON
R 474	4822 111 30067	33	5	CR16	CARBON
R 476	4822 111 30067	33	5	CR16	CARBON
R 477	4822 111 30067	33	5	CR16	CARBON
R 478	5322 116 54469	100	1	MR25	METAL FILM
R 479	5322 116 50621	536	1	MR25	METAL FILM
R 481	4822 111 30067	33	5	CR16	CARBON
R 482	5322 116 54469	100	1	MR25	METAL FILM
R 483	4822 111 30067	33	5	CR16	CARBON
R 484	5322 116 54613	8,66K	1	MR25	METAL FILM
R 486	5322 116 50524	3,01K	1	MR25	METAL FILM
R 487	5322 116 50527	33,2	1	MR25	METAL FILM
R 488	5322 116 54469	100	1	MR25	METAL FILM
R 500	5322 116 54469	100	1	MR25	METAL FILM
R 501	5322 116 54525	511	1	MR25	METAL FILM
R 502	5322 116 54549	1K	1	MR25	METAL FILM
R 503	5322 116 50452	10	1	MR25	METAL FILM
R 504	5322 116 50511	48,7	1	MR25	METAL FILM
R 505	5322 116 54469	100	1	MR25	METAL FILM
R 506	5322 116 54549	1K	1	MR25	METAL FILM
R 507	5322 116 54525	511	1	MR25	METAL FILM
R 511	5322 116 54258	9,53	1	MR25	METAL FILM
R 512	5322 116 50568	4,99	1	MR25	METAL FILM
R 513	5322 116 54258	9,53	1	MR25	METAL FILM
R 514	5322 116 50568	4,99	1	MR25	METAL FILM
R 516	5322 116 54258	9,53	1	MR25	METAL FILM
R 517	5322 116 54258	9,53	1	MR25	METAL FILM
R 520	5322 116 54469	100	1	MR25	METAL FILM
R 521	5322 116 54525	511	1	MR25	METAL FILM
R 522	5322 116 54549	1K	1	MR25	METAL FILM
R 523	5322 116 50452	10	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 524	5322 116 50511	48•7	1	MR25	METAL FILM
R 525	5322 116 54469	100	1	MR25	METAL FILM
R 526	5322 116 54549	1K	1	MR25	METAL FILM
R 527	5322 116 54525	511	1	MR25	METAL FILM
R 528	5322 116 50524	3•01K	1	MR25	METAL FILM
R 529	5322 116 54621	10•2K	1	MR25	METAL FILM
R 531	5322 101 14048	47K	20	0•5W	TRIMMING POTM
R 532	5322 116 50527	33•2	1	MR25	METAL FILM
R 533	5322 116 54643	20•5K	1	MR25	METAL FILM
R 534	4822 111 30324	100	5	CR16	CARBON
R 536	4822 111 30067	33	5	CR16	CARBON
R 537	5322 116 50676	196	1	MR25	METAL FILM
R 538	5322 116 50555	1•27K	1	MR25	METAL FILM
R 539	5322 116 50568	4•99	1	MR25	METAL FILM
R 541	5322 116 50676	196	1	MR25	METAL FILM
R 542	5322 116 54519	402	1	MR25	METAL FILM
R 543	5322 116 50593	16•2K	1	MR25	METAL FILM
R 544	5322 116 50452	10	1	MR25	METAL FILM
R 546	5322 116 54469	100	1	MR25	METAL FILM
R 547	5322 116 54541	825	1	MR25	METAL FILM
R 548	5322 101 14069	22K	20	0•5W	TRIMMING POTM
R 549	5322 116 54595	5•11K	1	MR25	METAL FILM
R 551	4822 111 30245	47	5	CR16	CARBON
R 552	5322 116 50452	10	1	MR25	METAL FILM
R 553	4822 111 30067	33	5	CR16	CARBON
R 554	5322 116 50506	154	1	MR25	METAL FILM
R 556	5322 116 50568	4•99	1	MR25	METAL FILM
R 557	5322 116 50511	48•7	1	MR25	METAL FILM
R 558	5322 116 54561	1•33K	1	MR25	METAL FILM
R 559	5322 116 50569	95•3	1	MR25	METAL FILM
R 560	4822 111 30324	100	5	CR16	CARBON
R 561	5322 116 50506	154	1	MR25	METAL FILM
R 562	5322 116 50511	48•7	1	MR25	METAL FILM
R 563	5322 116 54561	1•33K	1	MR25	METAL FILM
R 564	4822 111 30067	33	5	CR16	CARBON
R 566	5322 116 50452	10	1	MR25	METAL FILM
R 567	4822 111 30067	33	5	CR16	CARBON
R 568	4822 111 30245	47	5	CR16	CARBON
R 569	5322 116 50568	4•99	1	MR25	METAL FILM
R 571	5322 116 54005	3•32K	1	MR25	METAL FILM
R 572	5322 116 50569	95•3	1	MR25	METAL FILM
R 573	5322 116 50568	4•99	1	MR25	METAL FILM
R 574	5322 116 54258	9•53	1	MR25	METAL FILM
R 576	5322 116 50568	4•99	1	MR25	METAL FILM
R 577	5322 116 54258	9•53	1	MR25	METAL FILM
R 578	5322 116 54258	9•53	1	MR25	METAL FILM
R 579	5322 116 50568	4•99	1	MR25	METAL FILM
R 581	5322 116 50568	4•99	1	MR25	METAL FILM
R 601	5322 116 50926	40•2	1	MR25	METAL FILM
R 602	5322 116 54506	287	1	MR25	METAL FILM
R 603	4822 111 30067	33	5	CR16	CARBON
R 604	5322 116 54492	178	1	MR25	METAL FILM
R 606	5322 116 50676	196	1	MR25	METAL FILM
R 607	5322 116 54519	402	1	MR25	METAL FILM
R 608	4822 111 30067	33	5	CR16	CARBON
R 609	5322 116 54492	178	1	MR25	METAL FILM
R 610	5322 116 50524	3•01K	1	MR25	METAL FILM
R 611	5322 116 50926	40•2	1	MR25	METAL FILM
R 612	5322 116 54506	287	1	MR25	METAL FILM
R 613	5322 116 50506	154	1	MR25	METAL FILM
R 614	4822 111 30067	33	5	CR16	CARBON
R 615	5322 116 50524	3•01K	1	MR25	METAL FILM
R 616	5322 116 54444	53•6	1	MR25	METAL FILM
R 617	4822 111 30067	33	5	CR16	CARBON
R 618	5322 116 54444	53•6	1	MR25	METAL FILM
R 619	5322 101 14011	100	20	0•5W	TRIMMING POTM
R 621	5322 100 10114	4•7K	20	0•5W	TRIMMING POTM
R 622	5322 100 10113	10K	20	0•5W	TRIMMING POTM
R 623	5322 116 54613	8•66K	1	MR25	METAL FILM
R 624	5322 116 54619	10K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 627	4822 111 30245	47	5	CR16	CARBON
R 628	4822 111 30067	33	5	CR16	CARBON
R 629	5322 116 54608	7,5K	1	MR25	METAL FILM
R 630	4822 111 30067	33	5	CR16	CARBON
R 631	5322 116 50556	4,42K	1	MR25	METAL FILM
R 632	4822 111 30245	47	5	CR16	CARBON
R 633	4822 111 30067	33	5	CR16	CARBON
R 634	4822 111 30067	33	5	CR16	CARBON
R 636	4822 111 30067	33	5	CR16	CARBON
R 637	5322 116 50457	215	1	MR25	METAL FILM
R 638	5322 116 50669	205	1	MR25	METAL FILM
R 639	5322 116 54451	61,9	1	MR25	METAL FILM
R 641	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 642	5322 116 50457	215	1	MR25	METAL FILM
R 644	5322 116 50669	205	1	MR25	METAL FILM
R 646	5322 116 54451	61,9	1	MR25	METAL FILM
R 647	4822 111 30067	33	5	CR16	CARBON
R 648	4822 111 30245	47	5	CR16	CARBON
R 649	5322 116 50515	1,78K	1	MR25	METAL FILM
R 650	5322 116 54615	9,09K	1	MR25	METAL FILM
R 651	5322 116 54585	3,48K	1	MR25	METAL FILM
R 652	5322 116 50474	42,2K	1	MR25	METAL FILM
R 653	5322 116 50417	162	1	MR25	METAL FILM
R 654	5322 116 54011	5,62K	1	MR25	METAL FILM
R 655	5322 116 50904	30,1	1	MR25	METAL FILM
R 656	5322 116 54557	1,21K	1	MR25	METAL FILM
R 657	5322 116 50579	3,16K	1	MR25	METAL FILM
R 658	5322 116 54516	365	1	MR25	METAL FILM
R 659	4822 111 30067	33	5	CR16	CARBON
R 660	5322 116 54516	365	1	MR25	METAL FILM
R 661	5322 116 50509	4,87K	1	MR25	METAL FILM
R 662	5322 116 50579	3,16K	1	MR25	METAL FILM
R 663	5322 116 54012	6,81K	1	MR25	METAL FILM
R 664	5322 116 54557	1,21K	1	MR25	METAL FILM
R 665	5322 116 54615	9,09K	1	MR25	METAL FILM
R 666	5322 116 54011	5,62K	1	MR25	METAL FILM
R 667	4822 111 30245	47	5	CR16	CARBON
R 668	5322 116 50515	1,78K	1	MR25	METAL FILM
R 669	5322 116 54585	3,48K	1	MR25	METAL FILM
R 671	5322 116 50474	42,2K	1	MR25	METAL FILM
R 672	5322 116 50417	162	1	MR25	METAL FILM
R 681	5322 116 50568	4,99	1	MR25	METAL FILM
R 682	5322 116 50568	4,99	1	MR25	METAL FILM
R 683	5322 116 50568	4,99	1	MR25	METAL FILM
R 684	5322 101 20408	100K	20	0,1W	CARBON POTM LIN
R 700	5322 116 50527	33,2	1	MR25	METAL FILM
R 701	5322 116 54743	301K	1	MR25	METAL FILM
R 702	5322 116 54038	221K	1	MR25	METAL FILM
R 703	5322 116 54595	5,11K	1	MR25	METAL FILM
R 704	5322 116 54263	681K	1	MR30	METAL FILM
R 705	5322 101 14051	220	20	0,5W	TRIMMING POTM
R 706	5322 116 50452	10	1	MR25	METAL FILM
R 707	5322 116 50452	10	1	MR25	METAL FILM
R 708	5322 116 54005	3,32K	1	MR25	METAL FILM
R 709	5322 116 50452	10	1	MR25	METAL FILM
R 711	5322 116 54676	56,2K	1	MR25	METAL FILM
R 712	5322 116 50527	33,2	1	MR25	METAL FILM
R 713	5322 116 54585	3,48K	1	MR25	METAL FILM
R 714	5322 116 54549	1K	1	MR25	METAL FILM
R 716	5322 116 50527	33,2	1	MR25	METAL FILM
R 717	5322 116 54587	3,65K	1	MR25	METAL FILM
R 718	5322 116 50515	1,78K	1	MR25	METAL FILM
R 719	5322 116 54469	100	1	MR25	METAL FILM
R 720	5322 116 54525	511	1	MR25	METAL FILM
R 721	5322 116 50664	2,05K	1	MR25	METAL FILM
R 722	5322 116 54536	750	1	MR25	METAL FILM
R 723	5322 116 50452	10	1	MR25	METAL FILM
R 724	5322 116 50527	33,2	1	MR25	METAL FILM
R 725	5322 116 50954	38,3	1	MR25	METAL FILM
R 726	5322 116 50527	33,2	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 727	5322 116 50571	715	1	MR25	METAL FILM
R 728	5322 116 50636	2,74K	1	MR25	METAL FILM
R 729	5322 116 50452	10	1	MR25	METAL FILM
R 731	5322 116 54525	511	1	MR25	METAL FILM
R 732	5322 116 50664	2,05K	1	MR25	METAL FILM
R 733	5322 116 54536	750	1	MR25	METAL FILM
R 734	5322 116 50452	10	1	MR25	METAL FILM
R 735	5322 116 50635	1,47K	1	MR25	METAL FILM
R 736	5322 116 50527	33,2	1	MR25	METAL FILM
R 737	5322 116 50527	33,2	1	MR25	METAL FILM
R 738	5322 116 50571	715	1	MR25	METAL FILM
R 739	5322 116 50636	2,74K	1	MR25	METAL FILM
R 740	5322 116 50954	38,3	1	MR25	METAL FILM
R 741	5322 116 50452	10	1	MR25	METAL FILM
R 742	5322 116 50452	10	1	MR25	METAL FILM
R 743	5322 116 50452	10	1	MR25	METAL FILM
R 751	5322 116 54469	100	1	MR25	METAL FILM
R 752	5322 116 50452	10	1	MR25	METAL FILM
R 753	5322 116 54554	1,1K	1	MR25	METAL FILM
R 754	5322 116 54469	100	1	MR25	METAL FILM
R 756	5322 116 50452	10	1	MR25	METAL FILM
R 757	5322 116 54554	1,1K	1	MR25	METAL FILM
R 761	5322 116 54469	100	1	MR25	METAL FILM
R 762	5322 116 50452	10	1	MR25	METAL FILM
R 763	5322 116 54554	1,1K	1	MR25	METAL FILM
R 764	5322 116 54469	100	1	MR25	METAL FILM
R 766	5322 116 50452	10	1	MR25	METAL FILM
R 767	5322 116 54554	1,1K	1	MR25	METAL FILM
R 771	5322 116 54469	100	1	MR25	METAL FILM
R 772	5322 116 50452	10	1	MR25	METAL FILM
R 773	5322 116 54554	1,1K	1	MR25	METAL FILM
R 774	5322 116 54469	100	1	MR25	METAL FILM
R 776	5322 116 50452	10	1	MR25	METAL FILM
R 777	5322 116 54554	1,1K	1	MR25	METAL FILM
R 781	5322 116 54469	100	1	MR25	METAL FILM
R 782	5322 116 50452	10	1	MR25	METAL FILM
R 783	5322 116 54554	1,1K	1	MR25	METAL FILM
R 784	5322 116 54469	100	1	MR25	METAL FILM
R 786	5322 116 50452	10	1	MR25	METAL FILM
R 787	5322 116 54554	1,1K	1	MR25	METAL FILM
R 791	5322 116 54469	100	1	MR25	METAL FILM
R 792	5322 116 50452	10	1	MR25	METAL FILM
R 793	5322 116 54554	1,1K	1	MR25	METAL FILM
R 794	5322 116 54469	100	1	MR25	METAL FILM
R 796	5322 116 50452	10	1	MR25	METAL FILM
R 797	5322 116 54554	1,1K	1	MR25	METAL FILM
R 801	4822 111 30324	100	5	CR16	CARBON
R 802	5322 111 30396	22	5	CR16	CARBON
R 803	5322 116 54012	6,81K	1	MR25	METAL FILM
R 804	4822 111 30263	3,3K	5	CR16	CARBON
R 806	5322 116 50586	1,54K	1	MR25	METAL FILM
R 807	5322 116 50895	18,7	1	MR25	METAL FILM
R 808	5322 116 50895	18,7	1	MR25	METAL FILM
R 809	5322 111 30396	22	5	CR16	CARBON
R 811	5322 116 54012	6,81K	1	MR25	METAL FILM
R 812	5322 116 54525	511	1	MR25	METAL FILM
R 813	5322 111 30396	22	5	CR16	CARBON
R 814	5322 116 54592	4,02K	1	MR25	METAL FILM
R 816	5322 111 30396	22	5	CR16	CARBON
R 817	5322 116 50415	1,15K	1	MR25	METAL FILM
R 818	5322 116 50415	1,15K	1	MR25	METAL FILM
R 819	5322 111 30396	22	5	CR16	CARBON
R 821	4822 110 63054	10	5	CR25	CARBON
R 822	5322 116 54683	68,1K	1	MR25	METAL FILM
R 823	5322 116 50636	2,74K	1	MR25	METAL FILM
R 824	5322 116 54683	68,1K	1	MR25	METAL FILM
R 826	5322 116 54552	1,05K	1	MR25	METAL FILM
R 827	5322 116 50635	1,47K	1	MR25	METAL FILM
R 828	5322 116 50635	1,47K	1	MR25	METAL FILM
R 829	5322 116 54552	1,05K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 831	5322 111 30396	22	5	CR16	CARBON
R 832	5322 111 30396	22	5	CR16	CARBON
R 833	5322 116 50527	33,2	1	MR25	METAL FILM
R 834	5322 116 50506	154	1	MR25	METAL FILM
R 836	5322 116 54508	301	1	MR25	METAL FILM
R 837	5322 116 54552	1,05K	1	MR25	METAL FILM
R 838	5322 111 30396	22	5	CR16	CARBON
R 839	5322 116 54552	1,05K	1	MR25	METAL FILM
R 840	5322 111 30396	22	5	CR16	CARBON
R 841	5322 116 54576	2,37K	1	MR25	METAL FILM
R 842	5322 116 54519	402	1	MR25	METAL FILM
R 843	4822 110 63054	10	5	CR25	CARBON
R 844	4822 110 63054	10	5	CR25	CARBON
R 851	4822 110 63036	2,2	5	CR25	CARBON
R 852	4822 110 63036	2,2	5	CR25	CARBON
R 853	4822 110 63036	2,2	5	CR25	CARBON
R 854	4822 110 63036	2,2	5	CR25	CARBON
R 856	5322 116 54564	1,5K	1	MR25	METAL FILM
R 857	5322 111 44156	510	5	CR16	CARBON
R 858	5322 116 54549	1K	1	MR25	METAL FILM
R 859	5322 116 54619	10K	1	MR25	METAL FILM
R 861	5322 116 54629	14K	1	MR25	METAL FILM
R 862	5322 111 34094	620	5	CR16	CARBON
R 863	4822 111 30303	8,2K	5	CR16	CARBON
R 864	4822 111 30267	1,5K	5	CR16	CARBON
R 866	4822 111 30119	3K	5	CR16	CARBON
R 867	5322 116 50561	590	1	MR25	METAL FILM
R 868	5322 116 54011	5,62K	1	MR25	METAL FILM
R 869	5322 116 54585	3,48K	1	MR25	METAL FILM
R 871	5322 111 44153	15	5	CR16	CARBON
R 872	5322 116 54474	110	1	MR25	METAL FILM
R 873	5322 101 14069	22K	20	0,5W	TRIMMING POTM
R 874	5322 116 54661	34,8K	1	MR25	METAL FILM
R 876	5322 116 54619	10K	1	MR25	METAL FILM
R 877	5322 116 54597	5,36K	1	MR25	METAL FILM
R 878	5322 116 50415	1,15K	1	MR25	METAL FILM
R 879	5322 116 54481	130	1	MR25	METAL FILM
R 880	5322 116 54585	3,48K	1	MR25	METAL FILM
R 881	5322 116 50676	196	1	MR25	METAL FILM
R 882	5322 116 54696	100K	1	MR25	METAL FILM
R 883	5322 116 54632	14,7K	1	MR25	METAL FILM
R 884	5322 116 54632	14,7K	1	MR25	METAL FILM
R 885	5322 116 50583	5,9K	1	MR25	METAL FILM
R 886	5322 116 50481	22,6K	1	MR25	METAL FILM
R 887	5322 116 50459	422	1	MR25	METAL FILM
R 888	5322 116 54005	3,32K	1	MR25	METAL FILM
R 889	5322 116 54012	6,81K	1	MR25	METAL FILM
R 890	5322 116 50527	33,2	1	MR25	METAL FILM
R 891	5322 116 50675	2,26K	1	MR25	METAL FILM
R 892	5322 116 54619	10K	1	MR25	METAL FILM
R 893	4822 111 30067	33	5	CR16	CARBON
R 894	5322 116 50509	4,87K	1	MR25	METAL FILM
R 895	5322 116 50586	1,54K	1	MR25	METAL FILM
R 896	5322 116 50636	2,74K	1	MR25	METAL FILM
R 897	5322 116 54519	402	1	MR25	METAL FILM
R 898	5322 116 54534	681	1	MR25	METAL FILM
R 899	5322 116 50452	10	1	MR25	METAL FILM
R 900	4822 111 30067	33	5	CR16	CARBON
R 901	5322 116 54549	1K	1	MR25	METAL FILM
R 902	4822 111 30067	33	5	CR16	CARBON
R 903	5322 116 50527	33,2	1	MR25	METAL FILM
R 904	5322 116 50636	2,74K	1	MR25	METAL FILM
R 905	5322 116 54587	3,65K	1	MR25	METAL FILM
R 906	5322 111 30396	22	5	CR16	CARBON
R 907	5322 116 50556	4,42K	1	MR25	METAL FILM
R 908	4822 111 30067	33	5	CR16	CARBON
R 909	5322 116 50798	898	0,5	MR24C	METAL FILM
R 910	5322 116 54549	1K	1	MR25	METAL FILM
R 911	5322 116 50579	3,16K	1	MR25	METAL FILM
R 912	5322 116 50556	4,42K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 913	5322 116 50664	2,05K	1	MR25	METAL FILM
R 914	5322 100 10114	4,7K	20	0,5W	TRIMMING POTM
R 915	5322 116 54624	11,5K	1	MR25	METAL FILM
R 916	5322 116 50481	22,6K	1	MR25	METAL FILM
R 917	5322 116 54549	1K	1	MR25	METAL FILM
R 918	5322 116 54549	1K	1	MR25	METAL FILM
R 919	5322 116 50559	27,4K	1	MR25	METAL FILM
R 921	5322 116 50559	27,4K	1	MR25	METAL FILM
R 922	5322 116 50556	4,42K	1	MR25	METAL FILM
R 923	5322 116 50556	4,42K	1	MR25	METAL FILM
R 925	5322 116 54619	10K	1	MR25	METAL FILM
R 926	5322 116 54011	5,62K	1	MR25	METAL FILM
R 927	5322 116 54011	5,62K	1	MR25	METAL FILM
R 928	5322 111 30396	22	5	CR16	CARBON
R 929	5322 116 54627	13,3K	1	MR25	METAL FILM
R 931	4822 111 30352	82	5	CR16	CARBON
R 932	4822 111 30245	47	5	CR16	CARBON
R 933	5322 111 30396	22	5	CR16	CARBON
R 934	5322 111 30279	33K	5	CR16	CARBON
R 936	5322 116 54565	1,62K	1	MR25	METAL FILM
R 937	5322 111 44156	510	5	CR16	CARBON
R 939	5322 111 44156	510	5	CR16	CARBON
R 941	4822 111 30327	220	5	CR16	CARBON
R 942	5322 116 54632	14,7K	1	MR25	METAL FILM
R 944	5322 116 50664	2,05K	1	MR25	METAL FILM
R 946	5322 116 54608	7,5K	1	MR25	METAL FILM
R 947	5322 116 50508	487	1	MR25	METAL FILM
R 948	5322 116 54617	9,53K	1	MR25	METAL FILM
R 949	5322 116 54576	2,37K	1	MR25	METAL FILM
R 961	5322 116 54408	909K	1	MR30	METAL FILM
R 962	5322 116 54762	365K	1	MR30	METAL FILM
R 963	5322 116 54939	35,2K	0,5	MR24C	METAL FILM
R 964	5322 116 55167	17,2K	0,5	MR24C	METAL FILM
R 966	5322 116 55168	8,16K	0,5	MR24C	METAL FILM
R 967	5322 116 54832	2,71K	0,5	MR24C	METAL FILM
R 968	5322 116 50798	898	0,5	MR24C	METAL FILM
R 969	5322 116 54722	182K	1	MR25	METAL FILM
R 971	5322 116 54977	89,8K	0,5	MR24C	METAL FILM
R 976	5322 116 54549	1K	1	MR25	METAL FILM
R 977	5322 116 50729	4,22K	1	MR25	METAL FILM
R 978	5322 116 50451	21,5K	1	MR25	METAL FILM
R 979	5322 101 14069	22K	20	0,5W	TRIMMING POTM
R 981	5322 116 54005	3,32K	1	MR25	METAL FILM
R 982	5322 116 54549	1K	1	MR25	METAL FILM
R 983	5322 116 50484	4,64K	1	MR25	METAL FILM
R 984	5322 116 50664	2,05K	1	MR25	METAL FILM
R 986	5322 116 50451	21,5K	1	MR25	METAL FILM
R 987	5322 101 14069	22K	20	0,5W	TRIMMING POTM
R 1001	4822 111 30324	100	5	CR16	CARBON
R 1002	5322 111 30396	22	5	CR16	CARBON
R 1003	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1004	4822 111 30263	3,3K	5	CR16	CARBON
R 1006	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1007	5322 116 50895	18,7	1	MR25	METAL FILM
R 1008	5322 116 50895	18,7	1	MR25	METAL FILM
R 1009	5322 111 30396	22	5	CR16	CARBON
R 1011	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1012	5322 116 54525	511	1	MR25	METAL FILM
R 1013	5322 111 30396	22	5	CR16	CARBON
R 1014	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1016	5322 111 30396	22	5	CR16	CARBON
R 1017	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1018	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1019	5322 111 30396	22	5	CR16	CARBON
R 1021	4822 110 63054	10	5	CR25	CARBON
R 1022	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1023	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1024	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1026	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1027	5322 116 50635	1,47K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1028	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1029	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1031	5322 111 30396	22	5	CR16	CARBON
R 1032	5322 111 30396	22	5	CR16	CARBON
R 1033	5322 116 50527	33,2	1	MR25	METAL FILM
R 1034	5322 116 50506	154	1	MR25	METAL FILM
R 1036	5322 116 54508	301	1	MR25	METAL FILM
R 1037	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1038	5322 111 30396	22	5	CR16	CARBON
R 1039	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1040	5322 111 30396	22	5	CR16	CARBON
R 1041	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1042	5322 116 54519	402	1	MR25	METAL FILM
R 1043	4822 110 63054	10	5	CR25	CARBON
R 1044	4822 110 63054	10	5	CR25	CARBON
R 1051	4822 110 63036	2,2	5	CR25	CARBON
R 1052	4822 110 63036	2,2	5	CR25	CARBON
R 1053	4822 110 63063	22	5	CR25	CARBON
R 1054	4822 110 63036	2,2	5	CR25	CARBON
R 1056	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1057	5322 116 54525	511	1	MR25	METAL FILM
R 1058	5322 116 54474	110	1	MR25	METAL FILM
R 1059	5322 111 44153	15	5	CR16	CARBON
R 1061	5322 116 54532	649	1	MR25	METAL FILM
R 1062	5322 116 50729	4,22K	1	MR25	METAL FILM
R 1063	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1064	5322 101 14069	22K	20	0,5W	TRIMMING POTM
R 1065	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1066	5322 116 54629	14K	1	MR25	METAL FILM
R 1067	5322 116 54597	5,36K	1	MR25	METAL FILM
R 1068	5322 116 54597	5,36K	1	MR25	METAL FILM
R 1069	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1070	5322 116 54516	365	1	MR25	METAL FILM
R 1071	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1072	5322 116 54519	402	1	MR25	METAL FILM
R 1073	5322 116 54545	909	1	MR25	METAL FILM
R 1075	5322 111 30396	22	5	CR16	CARBON
R 1076	5322 116 54597	5,36K	1	MR25	METAL FILM
R 1077	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1078	5322 116 54603	6,49K	1	MR25	METAL FILM
R 1079	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1081	4822 111 30067	33	5	CR16	CARBON
R 1082	5322 116 54608	7,5K	1	MR25	METAL FILM
R 1083	5322 116 54635	16,9K	1	MR25	METAL FILM
R 1084	4822 111 30067	33	5	CR16	CARBON
R 1086	5322 116 50798	898	0,5	MR24C	METAL FILM
R 1087	4822 111 30067	33	5	CR16	CARBON
R 1088	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1089	5322 116 50527	33,2	1	MR25	METAL FILM
R 1091	4822 111 30067	33	5	CR16	CARBON
R 1092	5322 116 54587	3,65K	1	MR25	METAL FILM
R 1093	5322 116 50556	4,42K	1	MR25	METAL FILM
R 1094	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1096	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1097	5322 101 14069	22K	20	0,5W	TRIMMING POTM
R 1098	5322 116 54549	1K	1	MR25	METAL FILM
R 1099	5322 111 30278	27K	5	CR16	CARBON
R 1101	4822 111 30352	82	5	CR16	CARBON
R 1102	4822 111 30245	47	5	CR16	CARBON
R 1103	5322 111 30396	22	5	CR16	CARBON
R 1104	5322 111 30396	22	5	CR16	CARBON
R 1106	5322 111 30279	33K	5	CR16	CARBON
R 1107	5322 116 54565	1,62K	1	MR25	METAL FILM
R 1108	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1109	5322 116 50514	64,9K	1	MR25	METAL FILM
R 1111	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1112	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1113	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1114	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1115	5322 100 10113	10K	20	0,5W	TRIMMING POTM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1116	5322 116 54469	100	1	MR25	METAL FILM
R 1117	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1118	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1119	5322 116 54617	9,53K	1	MR25	METAL FILM
R 1121	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1122	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1123	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1124	4822 111 30067	33	5	CR16	CARBON
R 1126	4822 111 30067	33	5	CR16	CARBON
R 1127	5322 116 54617	9,53K	1	MR25	METAL FILM
R 1128	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1129	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1163	5322 116 54939	35,2K	0,5	MR24C	METAL FILM
R 1164	5322 116 55167	17,2K	0,5	MR24C	METAL FILM
R 1166	5322 116 55168	8,16K	0,5	MR24C	METAL FILM
R 1167	5322 116 54832	2,71K	0,5	MR24C	METAL FILM
R 1168	5322 116 50798	898	0,5	MR24C	METAL FILM
R 1169	5322 116 54722	182K	1	MR25	METAL FILM
R 1171	5322 116 54977	89,8K	0,5	MR24C	METAL FILM
R 1201	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1202	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1203	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1204	4822 111 30067	33	5	CR16	CARBON
R 1206	5322 116 54619	10K	1	MR25	METAL FILM
R 1207	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1208	5322 116 54619	10K	1	MR25	METAL FILM
R 1209	5322 101 14008	2,2K	20	0,5W	TRIMMING POTM
R 1211	5322 116 50621	536	1	MR25	METAL FILM
R 1212	5322 116 54524	499	1	MR25	METAL FILM
R 1213	5322 116 50621	536	1	MR25	METAL FILM
R 1214	5322 116 50511	48,7	1	MR25	METAL FILM
R 1216	5322 116 50457	215	1	MR25	METAL FILM
R 1217	4822 111 30333	1M	10	CR16	CARBON
R 1218	4822 111 30333	1M	10	CR16	CARBON
R 1219	5322 116 54619	10K	1	MR25	METAL FILM
R 1221	5322 116 50511	48,7	1	MR25	METAL FILM
R 1222	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1223	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1224	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1225	5322 116 50728	1,87K	1	MR25	METAL FILM
R 1226	5322 116 54615	9,09K	1	MR25	METAL FILM
R 1227	5322 116 54545	909	1	MR25	METAL FILM
R 1228	5322 116 54545	909	1	MR25	METAL FILM
R 1229	4822 111 30067	33	5	CR16	CARBON
R 1231	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1232	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1233	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1234	5322 116 54716	162K	1	MR25	METAL FILM
R 1235	5322 116 50673	147K	1	MR30	METAL FILM
R 1236	4822 111 30067	33	5	CR16	CARBON
R 1237	5322 116 54661	34,8K	1	MR25	METAL FILM
R 1238	4822 111 30067	33	5	CR16	CARBON
R 1239	5322 116 54549	1K	1	MR25	METAL FILM
R 1241	5322 116 54337	332K	1	MR30	METAL FILM
R 1242	5322 116 54661	34,8K	1	MR25	METAL FILM
R 1243	4822 111 30067	33	5	CR16	CARBON
R 1244	5322 116 54615	9,09K	1	MR25	METAL FILM
R 1246	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1247	5322 116 54587	3,65K	1	MR25	METAL FILM
R 1248	4822 111 30067	33	5	CR16	CARBON
R 1249	5322 116 54661	34,8K	1	MR25	METAL FILM
R 1251	5322 116 54661	34,8K	1	MR25	METAL FILM
R 1252	5322 116 54549	1K	1	MR25	METAL FILM
R 1253	5322 116 54188	1M	1	MR30	METAL FILM
R 1254	4822 111 30067	33	5	CR16	CARBON
R 1256	5322 116 54716	162K	1	MR25	METAL FILM
R 1257	4822 111 30067	33	5	CR16	CARBON
R 1258	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1301	5322 116 54534	681	1	MR25	METAL FILM
R 1302	5322 116 50586	1,54K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1303	5322 116 54532	649	1	MR25	METAL FILM
R 1304	5322 116 50492	46•4	1	MR25	METAL FILM
R 1306	5322 116 54571	1•96K	1	MR25	METAL FILM
R 1307	5322 116 50572	12•1K	1	MR25	METAL FILM
R 1308	5322 116 50767	2•15K	1	MR25	METAL FILM
R 1309	5322 116 54549	1K	1	MR25	METAL FILM
R 1311	5322 116 50635	1•47K	1	MR25	METAL FILM
R 1312	5322 116 50492	46•4	1	MR25	METAL FILM
R 1313	5322 116 50492	46•4	1	MR25	METAL FILM
R 1314	5322 116 54592	4•02K	1	MR25	METAL FILM
R 1316	5322 116 54469	100	1	MR25	METAL FILM
R 1317	5322 116 54619	10K	1	MR25	METAL FILM
R 1318	5322 116 50492	46•4	1	MR25	METAL FILM
R 1319	5322 116 50524	3•01K	1	MR25	METAL FILM
R 1321	5322 116 50452	10	1	MR25	METAL FILM
R 1322	5322 116 54694	90•9K	1	MR25	METAL FILM
R 1323	5322 116 54624	11•5K	1	MR25	METAL FILM
R 1324	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1325	5322 116 54627	13•3K	1	MR25	METAL FILM
R 1326	5322 116 50524	3•01K	1	MR25	METAL FILM
R 1327	5322 100 10113	10K	20	0•5W	TRIMMING POTM
R 1328	5322 116 50536	464	1	MR25	METAL FILM
R 1329	5322 116 54619	10K	1	MR25	METAL FILM
R 1330	5322 116 50568	4,99	1	MR25	METAL FILM
R 1331	5322 116 50442	48•7K	1	MR25	METAL FILM
R 1332	5322 116 50442	48•7K	1	MR25	METAL FILM
R 1333	4822 110 63187	1M	5	CR25	CARBON
R 1334	4822 110 63187	1M	5	CR25	CARBON
R 1336	5322 116 54525	511	1	MR25	METAL FILM
R 1337	4822 110 63161	100K	5	CR25	CARBON
R 1338	4822 110 42189	1•2M	5	VR37	CARBON
R 1339	4822 110 42196	2•2M	5	VR37	CARBON
R 1340	5322 116 54071	10•5	1	MR25	METAL FILM
R 1341	4822 110 42207	5•6M	5	VR37	CARBON
R 1342	5322 116 54689	82•5K	1	MR25	METAL FILM
R 1343	5322 116 54721	178K	1	MR25	METAL FILM
R 1344	5322 101 14071	100K	20	0•5W	TRIMMING POTM
R 1346	5322 101 14094	1M	20	0•5W	TRIMMING POTM
R 1347	5322 116 54704	121K	1	MR25	METAL FILM
R 1348	5322 116 54743	301K	1	MR25	METAL FILM
R 1349	5322 116 54696	100K	1	MR25	METAL FILM
R 1350	5322 116 54696	100K	1	MR25	METAL FILM
R 1351	5322 116 54619	10K	1	MR25	METAL FILM
R 1352	5322 116 54502	261	1	MR25	METAL FILM
R 1353	5322 116 54502	261	1	MR25	METAL FILM
R 1354	5322 116 54516	365	1	MR25	METAL FILM
R 1356	5322 116 50583	5•9K	1	MR25	METAL FILM
R 1357	5322 116 54549	1K	1	MR25	METAL FILM
R 1361	5322 116 54469	100	1	MR25	METAL FILM
R 1362	5322 100 10114	4•7K	20	0•5W	TRIMMING POTM
R 1363	5322 116 54576	2•37K	1	MR25	METAL FILM
R 1364	5322 116 50608	6•19K	1	MR25	METAL FILM
R 1366	5322 116 54533	665	1	MR25	METAL FILM
R 1367	5322 116 55008	499	0,1	MR24E	METAL FILM
R 1368	5322 116 54639	19•1K	1	MR25	METAL FILM
R 1369	5322 116 54502	261	1	MR25	METAL FILM
R 1371	5322 116 50608	6•19K	1	MR25	METAL FILM
R 1372	5322 116 54469	100	1	MR25	METAL FILM
R 1401	5322 116 54665	40•2K	1	MR25	METAL FILM
R 1402	5322 116 50442	48•7K	1	MR25	METAL FILM
R 1403	5322 116 54683	68•1K	1	MR25	METAL FILM
R 1404	5322 116 50474	42•2K	1	MR25	METAL FILM
R 1406	5322 116 54549	1K	1	MR25	METAL FILM
R 1407	5322 116 54696	100K	1	MR25	METAL FILM
R 1408	5322 116 54632	14•7K	1	MR25	METAL FILM
R 1409	5322 116 50672	51•1K	1	MR25	METAL FILM
R 1416	5322 111 50345	8•2M	5	1W	CARBON
R 1800	4822 110 63041	3•3	5	CR25	CARBON
R 1801	5322 113 60064	2•7	10	2W	WIRE-WOUND
R 1802	5322 116 54643	20•5K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1803	5322 116 54696	100K	1	MR25	METAL FILM
R 1804	5322 116 54696	100K	1	MR25	METAL FILM
R 1805	5322 116 54469	100	1	MR25	METAL FILM
R 1806	4822 110 63198	2•7M	10	CR25	CARBON
R 1807	5322 116 50442	48•7K	1	MR25	METAL FILM
R 1808	5322 116 54661	34•8K	1	MR25	METAL FILM
R 1811	4822 110 63041	3•3	5	CR25	CARBON
R 1814	5322 116 50766	147	1	MR25	METAL FILM
R 1815	5322 116 50557	46•4K	1	MR25	METAL FILM
R 1816	5322 116 54005	3•32K	1	MR25	METAL FILM
R 1818	5322 116 50417	162	1	MR25	METAL FILM
R 1819	5322 110 50035	2	5	CR37	CARBON
R 1820	5322 116 34028	150K	5	0•5W	NTC
R 1821	5322 116 55149	24•9K	1	MR30	METAL FILM
R 1822	5322 116 54549	1K	1	MR25	METAL FILM
R 1824	5322 116 50731	10•5K	1	MR25	METAL FILM
R 1826	5322 116 54549	1K	1	MR25	METAL FILM
R 1827	5322 116 54564	1•5K	1	MR25	METAL FILM
R 1828	5322 116 50636	2•74K	1	MR25	METAL FILM
R 1829	5322 116 50767	2•15K	1	MR25	METAL FILM
R 1830	5322 116 54619	10K	1	MR25	METAL FILM
R 1831	5322 116 54549	1K	1	MR25	METAL FILM
R 1832	5322 116 54558	8•25K	1	MR25	METAL FILM
R 1833	5322 116 50515	1•78K	1	MR25	METAL FILM
R 1834	5322 100 10112	1K	20	0•5W	TRIMMING POTM
R 1835	5322 116 54192	5•11	1	MR25	METAL FILM
R 1836	5322 116 54558	8•25K	1	MR25	METAL FILM
R 1837	4822 110 63178	470K	5	CR25	CARBON
R 1838	5322 116 54651	26•1K	1	MR25	METAL FILM
R 1839	5322 116 54592	4•02K	1	MR25	METAL FILM
R 1840	5322 116 54676	56•2K	1	MR25	METAL FILM
R 1841	5322 101 14102	500K	20		TRIMMING POTM
R 1842	5322 116 54655	30•1K	1	MR25	METAL FILM
R 1843	5322 116 54643	20•5K	1	MR25	METAL FILM
R 1844	5322 116 54643	20•5K	1	MR25	METAL FILM
R 1845	5322 116 54525	511	1	MR25	METAL FILM
R 1846	5322 116 54696	100K	1	MR25	METAL FILM
R 1847	5322 116 54469	100	1	MR25	METAL FILM
R 1848	5322 116 54469	100	1	MR25	METAL FILM
R 1849	5322 116 54619	10K	1	MR25	METAL FILM
R 1851	5322 116 54648	24•9K	1	MR25	METAL FILM
R 2376	5322 116 54012	6•81K	1	MR25	METAL FILM
R 2377	5322 116 54595	5•11K	1	MR25	METAL FILM
R 2378	5322 116 50558	18•7K	1	MR25	METAL FILM
R 2379	5322 101 14048	47K	20	0•5W	TRIMMING POTM
R 2381	5322 116 50527	33•2	1	MR25	METAL FILM
R 2382	4822 111 30067	33	5	CR16	CARBON
R 2383	5322 116 54557	1•21K	1	MR25	METAL FILM
R 2387	5322 116 50452	10	1	MR25	METAL FILM
R 2388	5322 116 54519	402	1	MR25	METAL FILM
R 2389	5322 116 54469	100	1	MR25	METAL FILM
R 2390	5322 116 54541	825	1	MR25	METAL FILM
R 2391	5322 116 50568	4•99	1	MR25	METAL FILM
R 2392	5322 116 50527	33•2	1	MR25	METAL FILM
R 2393	4822 111 30324	100	5	CR16	CARBON
R 2394	5322 116 54439	35•7	1	MR25	METAL FILM
R 2396	5322 116 54548	976	1	MR25	METAL FILM
R 2397	5322 116 54439	35•7	1	MR25	METAL FILM
R 2398	4822 111 30324	100	5	CR16	CARBON
R 2401	5322 116 50524	3•01K	1	MR25	METAL FILM
R 2402	5322 116 54508	301	1	MR25	METAL FILM
R 2403	4822 111 30067	33	5	CR16	CARBON
R 2404	5322 116 50524	3•01K	1	MR25	METAL FILM
R 2405	5322 116 54464	86•6	1	MR25	METAL FILM
R 2406	4822 111 30347	10	5	CR16	CARBON
R 2407	5322 116 50492	46•4	1	MR25	METAL FILM
R 2408	5322 116 50568	4•99	1	MR25	METAL FILM
R 2409	5322 116 50492	46•4	1	MR25	METAL FILM
R 2410	5322 116 34036	47	5	0•5W	NTC
R 2411	4822 111 30347	10	5	CR16	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 2412	4822 111 30067	33	5	CR16	CARBON
R 2413	5322 116 50515	1,78K	1	MR25	METAL FILM
R 2414	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2416	5322 116 50452	10	1	MR25	METAL FILM
R 2417	5322 116 50571	715	1	MR25	METAL FILM
R 2418	4822 111 30245	47	5	CR16	CARBON
R 2419	4822 111 30347	10	5	CR16	CARBON
R 2420	5322 116 54464	86,6	1	MR25	METAL FILM
R 2421	4822 111 30067	33	5	CR16	CARBON
R 2422	5322 116 54492	178	1	MR25	METAL FILM
R 2423	4822 111 30067	33	5	CR16	CARBON
R 2424	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2426	5322 116 54587	3,65K	1	MR25	METAL FILM
R 2427	5322 116 50527	33,2	1	MR25	METAL FILM
R 2428	4822 111 30067	33	5	CR16	CARBON
R 2429	5322 116 54492	178	1	MR25	METAL FILM
R 2431	4822 111 30347	10	5	CR16	CARBON
R 2432	5322 116 50571	715	1	MR25	METAL FILM
R 2433	4822 111 30245	47	5	CR16	CARBON
R 2434	5322 116 50452	10	1	MR25	METAL FILM
R 2436	4822 111 30067	33	5	CR16	CARBON
R 2437	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2438	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2439	4822 111 30067	33	5	CR16	CARBON
R 2440	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2441	5322 116 50926	40,2	1	MR25	METAL FILM
R 2442	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 2443	5322 116 54515	348	1	MR25	METAL FILM
R 2444	5322 116 50926	40,2	1	MR25	METAL FILM
R 2445	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2446	4822 111 30067	33	5	CR16	CARBON
R 2447	5322 116 50442	48,7K	1	MR25	METAL FILM
R 2448	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 2461	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2463	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2464	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2465	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2466	5322 116 54585	3,48K	1	MR25	METAL FILM
R 2467	4822 111 30067	33	5	CR16	CARBON
R 2468	4822 111 30067	33	5	CR16	CARBON
R 2469	4822 111 30067	33	5	CR16	CARBON
R 2471	4822 111 30067	33	5	CR16	CARBON
R 2472	4822 111 30067	33	5	CR16	CARBON
R 2473	4822 111 30067	33	5	CR16	CARBON
R 2474	4822 111 30067	33	5	CR16	CARBON
R 2476	4822 111 30067	33	5	CR16	CARBON
R 2477	4822 111 30067	33	5	CR16	CARBON
R 2478	5322 116 54469	100	1	MR25	METAL FILM
R 2479	5322 116 50621	536	1	MR25	METAL FILM
R 2481	4822 111 30067	33	5	CR16	CARBON
R 2482	5322 116 54469	100	1	MR25	METAL FILM
R 2483	4822 111 30067	33	5	CR16	CARBON
R 2484	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2486	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2487	5322 116 50527	33,2	1	MR25	METAL FILM
R 2488	5322 116 54469	100	1	MR25	METAL FILM
R 2576	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2577	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2578	5322 116 50558	18,7K	1	MR25	METAL FILM
R 2579	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 2581	5322 116 50527	33,2	1	MR25	METAL FILM
R 2582	4822 111 30067	33	5	CR16	CARBON
R 2583	5322 116 54557	1,21K	1	MR25	METAL FILM
R 2587	5322 116 50452	10	1	MR25	METAL FILM
R 2588	5322 116 54519	402	1	MR25	METAL FILM
R 2589	5322 116 54469	100	1	MR25	METAL FILM
R 2590	5322 116 54541	825	1	MR25	METAL FILM
R 2591	5322 116 50568	4,99	1	MR25	METAL FILM
R 2592	5322 116 50527	33,2	1	MR25	METAL FILM
R 2593	4822 111 30324	100	5	CR16	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 2594	5322 116 54439	35,7	1	MR25	METAL FILM
R 2596	5322 116 54548	976	1	MR25	METAL FILM
R 2597	5322 116 54439	35,7	1	MR25	METAL FILM
R 2598	4822 111 30324	100	5	CR16	CARBON
R 2601	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2602	5322 116 54508	301	1	MR25	METAL FILM
R 2603	4822 111 30067	33	5	CR16	CARBON
R 2604	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2605	5322 116 54464	86,6	1	MR25	METAL FILM
R 2606	4822 111 30347	10	5	CR16	CARBON
R 2607	5322 116 50492	46,4	1	MR25	METAL FILM
R 2608	5322 116 50568	4,99	1	MR25	METAL FILM
R 2609	5322 116 50492	46,4	1	MR25	METAL FILM
R 2610	5322 116 34036	47	5	0,5W	NTC
R 2611	4822 111 30347	10	5	CR16	CARBON
R 2612	4822 111 30067	33	5	CR16	CARBON
R 2613	5322 116 50515	1,78K	1	MR25	METAL FILM
R 2614	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2616	5322 116 50452	10	1	MR25	METAL FILM
R 2617	5322 116 50571	715	1	MR25	METAL FILM
R 2618	4822 111 30245	47	5	CR16	CARBON
R 2619	4822 111 30347	10	5	CR16	CARBON
R 2620	5322 116 54464	86,6	1	MR25	METAL FILM
R 2621	4822 111 30067	33	5	CR16	CARBON
R 2622	5322 116 54492	178	1	MR25	METAL FILM
R 2623	4822 111 30067	33	5	CR16	CARBON
R 2624	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2626	5322 116 54587	3,65K	1	MR25	METAL FILM
R 2627	5322 116 50527	33,2	1	MR25	METAL FILM
R 2628	4822 111 30067	33	5	CR16	CARBON
R 2629	5322 116 54492	178	1	MR25	METAL FILM
R 2631	4822 111 30347	10	5	CR16	CARBON
R 2632	5322 116 50571	715	1	MR25	METAL FILM
R 2633	4822 111 30245	47	5	CR16	CARBON
R 2634	5322 116 50452	10	1	MR25	METAL FILM
R 2636	4822 111 30067	33	5	CR16	CARBON
R 2637	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2638	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2639	4822 111 30067	33	5	CR16	CARBON
R 2640	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2641	5322 116 50926	40,2	1	MR25	METAL FILM
R 2642	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 2643	5322 116 54515	348	1	MR25	METAL FILM
R 2644	5322 116 50926	40,2	1	MR25	METAL FILM
R 2645	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2646	4822 111 30067	33	5	CR16	CARBON
R 2647	5322 116 50442	48,7K	1	MR25	METAL FILM
R 2648	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 2661	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2663	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2664	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2665	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2666	5322 116 54585	3,48K	1	MR25	METAL FILM
R 2667	4822 111 30067	33	5	CR16	CARBON
R 2668	4822 111 30067	33	5	CR16	CARBON
R 2669	4822 111 30067	33	5	CR16	CARBON
R 2671	4822 111 30067	33	5	CR16	CARBON
R 2672	4822 111 30067	33	5	CR16	CARBON
R 2673	4822 111 30067	33	5	CR16	CARBON
R 2674	4822 111 30067	33	5	CR16	CARBON
R 2676	4822 111 30067	33	5	CR16	CARBON
R 2677	4822 111 30067	33	5	CR16	CARBON
R 2678	5322 116 54469	100	1	MR25	METAL FILM
R 2679	5322 116 50621	536	1	MR25	METAL FILM
R 2681	4822 111 30067	33	5	CR16	CARBON
R 2682	5322 116 54469	100	1	MR25	METAL FILM
R 2683	4822 111 30067	33	5	CR16	CARBON
R 2684	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2686	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2687	5322 116 50527	33,2	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 2688	5322 116 54469	100	1	MR25	METAL FILM
R 2776	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2777	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2778	5322 116 50558	18,7K	1	MR25	METAL FILM
R 2779	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 2781	5322 116 50527	33,2	1	MR25	METAL FILM
R 2782	4822 111 30067	33	5	CR16	CARBON
R 2783	5322 116 54557	1,21K	1	MR25	METAL FILM
R 2787	5322 116 50452	10	1	MR25	METAL FILM
R 2788	5322 116 54519	402	1	MR25	METAL FILM
R 2789	5322 116 54469	100	1	MR25	METAL FILM
R 2790	5322 116 54541	825	1	MR25	METAL FILM
R 2791	5322 116 50568	4,99	1	MR25	METAL FILM
R 2792	5322 116 50527	33,2	1	MR25	METAL FILM
R 2793	4822 111 30324	100	5	CR16	CARBON
R 2794	5322 116 54439	35,7	1	MR25	METAL FILM
R 2796	5322 116 54548	976	1	MR25	METAL FILM
R 2797	5322 116 54439	35,7	1	MR25	METAL FILM
R 2798	4822 111 30324	100	5	CR16	CARBON
R 2801	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2802	5322 116 54508	301	1	MR25	METAL FILM
R 2803	4822 111 30067	33	5	CR16	CARBON
R 2804	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2805	5322 116 54464	86,6	1	MR25	METAL FILM
R 2806	4822 111 30347	10	5	CR16	CARBON
R 2807	5322 116 50492	46,4	1	MR25	METAL FILM
R 2808	5322 116 50568	4,99	1	MR25	METAL FILM
R 2809	5322 116 50492	46,4	1	MR25	METAL FILM
R 2810	5322 116 34036	47	5	0,5W	NTC
R 2811	4822 111 30347	10	5	CR16	CARBON
R 2812	4822 111 30067	33	5	CR16	CARBON
R 2813	5322 116 50515	1,78K	1	MR25	METAL FILM
R 2814	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2816	5322 116 50452	10	1	MR25	METAL FILM
R 2817	5322 116 50571	715	1	MR25	METAL FILM
R 2818	4822 111 30245	47	5	CR16	CARBON
R 2819	4822 111 30347	10	5	CR16	CARBON
R 2820	5322 116 54464	86,6	1	MR25	METAL FILM
R 2821	4822 111 30067	33	5	CR16	CARBON
R 2822	5322 116 54492	178	1	MR25	METAL FILM
R 2823	4822 111 30067	33	5	CR16	CARBON
R 2824	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2826	5322 116 54587	3,65K	1	MR25	METAL FILM
R 2827	5322 116 50527	33,2	1	MR25	METAL FILM
R 2828	4822 111 30067	33	5	CR16	CARBON
R 2829	5322 116 54492	178	1	MR25	METAL FILM
R 2831	4822 111 30347	10	5	CR16	CARBON
R 2832	5322 116 50571	715	1	MR25	METAL FILM
R 2833	4822 111 30245	47	5	CR16	CARBON
R 2834	5322 116 50452	10	1	MR25	METAL FILM
R 2836	4822 111 30067	33	5	CR16	CARBON
R 2837	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2838	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2839	4822 111 30067	33	5	CR16	CARBON
R 2840	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2841	5322 116 50926	40,2	1	MR25	METAL FILM
R 2842	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 2843	5322 116 54515	348	1	MR25	METAL FILM
R 2844	5322 116 50926	40,2	1	MR25	METAL FILM
R 2845	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2846	4822 111 30067	33	5	CR16	CARBON
R 2847	5322 116 50442	48,7K	1	MR25	METAL FILM
R 2848	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 2861	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2863	5322 116 54576	2,37K	1	MR25	METAL FILM
R 2864	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2865	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2866	5322 116 54585	3,48K	1	MR25	METAL FILM
R 2867	4822 111 30067	33	5	CR16	CARBON
R 2868	4822 111 30067	33	5	CR16	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 2869	4822 111 30067	33	5	CR16	CARBON
R 2871	4822 111 30067	33	5	CR16	CARBON
R 2872	4822 111 30067	33	5	CR16	CARBON
R 2873	4822 111 30067	33	5	CR16	CARBON
R 2874	4822 111 30067	33	5	CR16	CARBON
R 2876	4822 111 30067	33	5	CR16	CARBON
R 2877	4822 111 30067	33	5	CR16	CARBON
R 2878	5322 116 54469	100	1	MR25	METAL FILM
R 2879	5322 116 50621	536	1	MR25	METAL FILM
R 2881	4822 111 30067	33	5	CR16	CARBON
R 2882	5322 116 54469	100	1	MR25	METAL FILM
R 2883	4822 111 30067	33	5	CR16	CARBON
R 2884	5322 116 54613	8,66K	1	MR25	METAL FILM
R 2886	5322 116 50524	3,01K	1	MR25	METAL FILM
R 2887	5322 116 50527	33,2	1	MR25	METAL FILM
R 2888	5322 116 54469	100	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
DIODES		
GR1	5322 130 34595	CQY24A-I
GR2	5322 130 34595	CQY24A-I
GR101	5322 130 34037	BAV45
GR401	5322 130 30613	BAW62
GR501	5322 130 30613	BAW62
GR502	5322 130 34278	BZX79-C6V8
GR601	5322 130 30644	BA182
GR602	5322 130 30644	BA182
GR603	4822 130 30862	BZX79-C9V1
GR604	4822 130 30861	BZX79/B7V5
GR606	5322 130 34382	BZX79/B8V2
GR607	5322 130 34382	BZX79/B8V2
GR608	4822 130 30861	BZX79/B7V5
GR609	4822 130 30862	BZX79-C9V1
GR701	5322 130 30613	BAW62
GR702	5322 130 30613	BAW62
GR703	5322 130 30613	BAW62
GR704	5322 130 30613	BAW62
GR705	5322 130 30613	BAW62
GR706	5322 130 30613	BAW62
GR707	5322 130 30613	BAW62
GR708	5322 130 30613	BAW62
GR709	5322 130 30613	BAW62
GR710	5322 130 30613	BAW62
GR711	5322 130 30613	BAW62
GR712	5322 130 30613	BAW62
GR713	5322 130 34173	BZX79-B5V6
GR751	5322 130 30613	BAW62
GR752	5322 130 30613	BAW62
GR753	5322 130 30613	BAW62
GR754	5322 130 30613	BAW62
GR756	5322 130 30613	BAW62
GR757	5322 130 30613	BAW62
GR761	5322 130 30613	BAW62
GR762	5322 130 30613	BAW62
GR763	5322 130 30613	BAW62
GR764	5322 130 30613	BAW62
GR766	5322 130 30613	BAW62
GR767	5322 130 30613	BAW62
GR771	5322 130 30613	BAW62
GR772	5322 130 30613	BAW62
GR773	5322 130 30613	BAW62
GR774	5322 130 30613	BAW62
GR776	5322 130 30613	BAW62
GR777	5322 130 30613	BAW62
GR781	5322 130 30613	BAW62
GR782	5322 130 30613	BAW62

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
GR783	5322 130 30613	BAW62
GR784	5322 130 30613	BAW62
GR786	5322 130 30613	BAW62
GR787	5322 130 30613	BAW62
GR791	5322 130 30613	BAW62
GR792	5322 130 30613	BAW62
GR793	5322 130 30613	BAW62
GR794	5322 130 30613	BAW62
GR796	5322 130 30613	BAW62
GR797	5322 130 30613	BAW62
GR801	5322 130 34048	BZX79-C2V8
GR802	5322 130 30613	BAW62
GR803	5322 130 30613	BAW62
GR804	5322 130 30613	BAW62
GR806	5322 130 30613	BAW62
GR851	5322 130 30613	BAW62
GR853	5322 130 30613	BAW62
GR854	5322 130 30613	BAW62
GR855	5322 130 30229	AAZ15
GR856	5322 130 30613	BAW62
GR857	5322 130 30613	BAW62
GR858	5322 130 34174	BZX79-C4V7
GR861	5322 130 30613	BAW62
GR862	5322 130 30613	BAW62
GR863	5322 130 30613	BAW62
GR1001	5322 130 34048	BZX79-C2V8
GR1002	5322 130 30613	BAW62
GR1003	5322 130 30613	BAW62
GR1004	5322 130 30613	BAW62
GR1006	5322 130 30613	BAW62
GR1051	5322 130 30613	BAW62
GR1052	5322 130 30613	BAW62
GR1053	5322 130 30613	BAW62
GR1054	5322 130 30613	BAW62
GR1056	5322 130 30613	BAW62
GR1057	5322 130 30613	BAW62
GR1058	5322 130 30613	BAW62
GR1059	5322 130 30613	BAW62
GR1061	5322 130 30613	BAW62
GR1062	5322 130 30613	BAW62
GR1063	5322 130 30613	BAW62
GR1064	5322 130 30613	BAW62
GR1065	5322 130 30613	BAW62
GR1066	5322 130 30613	BAW62
GR1067	5322 130 30613	BAW62
GR1201	5322 130 30613	BAW62
GR1202	5322 130 30613	BAW62
GR1203	5322 130 30613	BAW62
GR1204	5322 130 30613	BAW62
GR1207	5322 130 34173	BZX79-C5V6
GR1208	5322 130 34384	BZX79-B62
GR1209	5322 130 34383	BZX79-B47
GR1211	5322 130 34384	BZX79-B62
GR1212	5322 130 34173	BZX79-C5V6
GR1301	5322 130 30613	BAW62
GR1302	5322 130 30613	BAW62
GR1303	5322 130 30392	BZY88-C3V3
GR1304	5322 130 30613	BAW62
GR1306	4822 130 30842	BAV21
GR1307	4822 130 30842	BAV21
GR1308	4822 130 30842	BAV21
GR1309	4822 130 30842	BAV21
GR1311	5322 130 30613	BAW62
GR1312	5322 130 30613	BAW62
GR1316	5322 130 34173	BZX79-C5V6
GR1317	5322 130 34173	BZX79-C5V6
GR1401	4822 130 30842	BAV21
GR1402	4822 130 30842	BAV21
GR1403	5322 130 34594	BY409

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
GR1416	5322 130 34594	BY409
GR1417	5322 130 34594	BY409
GR1418	5322 130 34594	BY409
GR1419	5322 130 34594	BY409
GR1421	5322 130 34594	BY409
GR1801	5322 130 30521	BY179
GR1802	5322 130 34107	BZX61-C13
GR1803	5322 130 34297	BZX79-C10
GR1804	4822 130 30817	BYX55/600
GR1805	5322 130 34605	BAX12
GR1806	5322 130 34034	BZX61-C75
GR1807	5322 130 30565	BZX61-C47
GR1808	5322 130 30613	BAW62
GR1809	4822 130 30839	BY206
GR1811	4822 130 30839	BY206
GR1812	4822 130 30839	BY206
GR1813	5322 130 30613	BAW62
GR1815	5322 130 30613	BAW62
GR1816	5322 130 34047	BZX75-C1V4
GR1817	5322 130 30613	BAW62
GR1818	5322 130 30613	BAW62
GR1819	5322 130 30195	BYX10
GR1820	5322 130 30613	BAW62
GR1821	5322 130 34297	BZX79-C10
GR1822	5322 130 34605	BAX12
GR1823	4822 130 30839	BY206
GR1824	4822 130 30839	BY206
GR1825	4822 130 20039	BR 100
GR1826	4822 130 30839	BY206
GR1827	4822 130 30839	BY206
GR1828	4822 130 30839	BY206
GR1829	4822 130 30839	BY206
GR1830	5322 130 30613	BAW62
GR1831	5322 130 34605	BAX12
GR1832	5322 130 34605	BAX12
GR1833	5322 130 34605	BAX12
GR1834	5322 130 34605	BAX12
GR1835	5322 130 30765	BZX75-C3V6
GR1836	5322 130 34605	BAX12
GR1837	5322 130 34605	BAX12
GR1838	5322 130 34605	BAX12
GR1839	5322 130 34605	BAX12
GR1841	5322 130 34605	BAX12
GR1842	5322 130 34605	BAX12
GR1843	5322 130 34605	BAX12
GR1844	5322 130 34605	BAX12
GR2401	5322 130 30613	BAW62
GR2601	5322 130 30613	BAW62
GR2801	5322 130 30613	BAW62
TRANSISTORS		
TS201	5322 130 40417	BSX20
TS202	5322 130 40417	BSX20
TS203	4822 130 40964	BC549
TS204	4822 130 40964	BC549
TS376	5322 130 44154	BF199
TS377	4822 130 40964	BC549
TS378	5322 130 44396	BF324
TS379	5322 130 44154	BF199
TS401	4822 130 40964	BC549
TS402	5322 130 44396	BF324
TS403	5322 130 44396	BF324
TS404	4822 130 40964	BC549
TS409	4822 130 40964	BC549
TS411	4822 130 40964	BC549
TS412	4822 130 40964	BC549
TS413	4822 130 40964	BC549
TS414	4822 130 40964	BC549
TS416	4822 130 40964	BC549

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS417	4822 130 40964	BC549
TS501	4822 130 40963	BC559
TS502	4822 130 40963	BC559
TS503	4822 130 40963	BC559
TS504	4822 130 40963	BC559
TS506	5322 130 44154	BF199
TS507	4822 130 40964	BC549
TS508	5322 130 44154	BF199
TS509	5322 130 44396	BF324
TS511	5322 130 40664	BD137
TS601	5322 130 44396	BF324
TS602	5322 130 44396	BF324
TS603	4822 130 40964	BC549
TS604	5322 130 40142	FW5324
TS606	5322 130 40673	FW5497
TS607	5322 130 40673	FW5497
TS608	5322 130 40142	FW5324
TS611	5322 130 44257	BC547
TS612	5322 130 44256	BC557
TS701	5322 130 44246	BC549C
TS702	4822 130 40963	BC559
TS703	4822 130 40963	BC559
TS704	5322 130 44154	BF199
TS705	4822 130 40964	BC549
TS706	5322 130 44154	BF199
TS707	5322 130 44154	BF199
TS708	5322 130 44154	BF199
TS709	4822 130 40854	BC327
TS751	5322 130 44396	BF324
TS752	5322 130 44396	BF324
TS761	5322 130 44396	BF324
TS762	5322 130 44396	BF324
TS771	5322 130 44396	BF324
TS772	5322 130 44396	BF324
TS781	5322 130 44396	BF324
TS782	5322 130 44396	BF324
TS791	5322 130 44396	BF324
TS792	5322 130 44396	BF324
TS801	5322 130 44246	BC549C
TS802	5322 130 40493	BFY90
TS803	4822 130 40964	BC549
TS804	5322 130 40493	BFY90
TS806	4822 130 40964	BC549
TS807	5322 130 40493	BFY90
TS808	5322 130 40493	BFY90
TS809	4822 130 40964	BC549
TS811	5322 130 44338	BFS17R
TS812	5322 130 40781	BFS17
TS851	5322 130 44338	BFS17R
TS852	5322 130 44359	537BSY
TS853	4822 130 40963	BC559
TS854	4822 130 40964	BC549
TS856	5322 130 40781	BFS17
TS857	5322 130 40781	BFS17
TS858	5322 130 44338	BFS17R
TS859	4822 130 40964	BC549
TS861	4822 130 40964	BC549
TS862	4822 130 40964	BC549
TS863	5322 130 40493	BFY90
TS864	4822 130 40963	BC559
TS865	4822 130 40964	BC549
TS866	4822 130 40963	BC559
TS867	4822 130 40963	BC559
TS868	5322 130 40417	BSX20
TS869	4822 130 40964	BC549
TS870	5322 130 40417	BSX20
TS871	4822 130 40963	BC559
TS872	4822 130 40964	BC549
TS873	4822 130 40964	BC549

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS874	5322 130 44246	BC549C
TS876	5322 130 44246	BC549C
TS877	4822 130 40964	BC549
TS878	4822 130 40964	BC549
TS879	4822 130 40964	BC549
TS881	4822 130 40964	BC549
TS882	4822 130 40964	BC549
TS883	5322 130 44396	BF324
TS884	5322 130 44396	BF324
TS886	4822 130 40963	BC559
TS887	5322 130 44246	BC549C
TS888	5322 130 44246	BC549C
TS1001	4822 130 40964	BC549
TS1002	5322 130 40493	BFY90
TS1003	4822 130 40964	BC549
TS1004	5322 130 40493	BFY90
TS1006	4822 130 40964	BC549
TS1007	5322 130 40493	BFY90
TS1008	5322 130 40493	BFY90
TS1009	4822 130 40964	BC549
TS1011	5322 130 40781	BFS17
TS1012	5322 130 44338	BFS17R
TS1051	5322 130 40781	BFS17
TS1052	5322 130 40781	BFS17
TS1053	5322 130 44338	BFS17R
TS1054	4822 130 40963	BC559
TS1056	5322 130 40781	BFS17
TS1057	4822 130 40963	BC559
TS1058	4822 130 40963	BC559
TS1059	4822 130 40964	BC549
TS1061	5322 130 40417	BSX20
TS1062	4822 130 40963	BC559
TS1063	4822 130 40964	BC549
TS1064	4822 130 40964	BC549
TS1066	4822 130 40964	BC549
TS1067	4822 130 40964	BC549
TS1068	4822 130 40963	BC559
TS1069	4822 130 40963	BC559
TS1071	4822 130 40964	BC549
TS1072	4822 130 40963	BC559
TS1201	4822 130 40964	BC549
TS1202	4822 130 40964	BC549
TS1203	4822 130 40964	BC549
TS1204	4822 130 40964	BC549
TS1206	5322 130 40018	2N2894
TS1207	5322 130 40018	2N2894
TS1208	4822 130 40908	BF336
TS1209	5322 130 40672	BFW44
TS1211	5322 130 44127	2N2894A
TS1212	5322 130 40417	BSX20
TS1213	4822 130 40908	BF336
TS1214	5322 130 40672	BFW44
TS1301	4822 130 40964	BC549
TS1302	5322 130 40018	2N2894
TS1303	5322 130 40321	BSX21
TS1304	5322 130 40321	BSX21
TS1306	5322 130 40321	BSX21
TS1307	5322 130 40373	BCY71
TS1308	5322 130 40321	BSX21
TS1309	5322 130 40712	BD136
TS1311	5322 130 40712	BD136
TS1317	5322 130 40712	BD136
TS1401	5322 130 40373	BCY71
TS1402	5322 130 40714	BSW68
TS1801	5322 130 44357	BD262
TS1802	5322 130 44246	BC549C
TS1807	5322 130 44105	BDY93
TS1808	5322 130 44358	BC559B
TS1809	5322 130 44019	BSX60

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS1811	5322 130 40482	BRY39
TS1812	5322 130 44246	BC549C
TS1813	5322 130 44395	CNY43
TS2376	5322 130 44154	BF199
TS2377	4822 130 40964	BC549
TS2378	5322 130 44396	BF324
TS2379	5322 130 44154	BF199
TS2401	4822 130 40964	BC549
TS2402	5322 130 44396	BF324
TS2403	5322 130 44396	BF324
TS2404	4822 130 40964	BC549
TS2409	4822 130 40964	BC549
TS2411	4822 130 40964	BC549
TS2412	4822 130 40964	BC549
TS2413	4822 130 40964	BC549
TS2414	4822 130 40964	BC549
TS2416	4822 130 40964	BC549
TS2417	4822 130 40964	BC549
TS2576	5322 130 44154	BF199
TS2577	4822 130 40964	BC549
TS2578	5322 130 44396	BF324
TS2579	5322 130 44154	BF199
TS2601	4822 130 40964	BC549
TS2602	5322 130 44396	BF324
TS2603	5322 130 44396	BF324
TS2604	4822 130 40964	BC549
TS2609	4822 130 40964	BC549
TS2611	4822 130 40964	BC549
TS2612	4822 130 40964	BC549
TS2613	4822 130 40964	BC549
TS2614	4822 130 40964	BC549
TS2616	4822 130 40964	BC549
TS2617	4822 130 40964	BC549
TS2776	5322 130 44154	BF199
TS2777	4822 130 40964	BC549
TS2778	5322 130 44396	BF324
TS2779	5322 130 44154	BF199
TS2801	4822 130 40964	BC549
TS2802	5322 130 44396	BF324
TS2803	5322 130 44396	BF324
TS2804	4822 130 40964	BC549
TS2809	4822 130 40964	BC549
TS2811	4822 130 40964	BC549
TS2812	4822 130 40964	BC549
TS2813	4822 130 40964	BC549
TS2814	4822 130 40964	BC549
TS2816	4822 130 40964	BC549
TS2817	4822 130 40964	BC549
INTEGRATED CIRCUITS		
IC101	5322 209 84424	TF CIRCUIT
IC201	5322 209 84823	SN74LS00N-00
IC202	5322 209 84823	SN74LS00N-00
IC203	5322 209 85486	SN74LS04N-00
IC204	5322 209 84823	SN74LS00N-00
IC206	5322 209 84986	SN74LS74N-00
IC207	5322 209 84823	SN74LS00N-00
IC208	5322 209 85265	SN74LS03N-00
IC209	5322 209 84986	SN74LS74N-00
IC211	5322 209 84823	SN74LS00N-00
IC212	5322 209 84823	SN74LS00N-00
IC213	5322 209 85265	SN74LS03N-00
IC214	5322 209 84986	SN74LS74N-00
IC216	5322 209 84823	SN74LS00N-00
IC217	5322 209 85312	SN74LS02N-00
IC401	5322 209 84355	OQ002
IC402	5322 209 84355	OQ002
IC501	5322 209 84355	OQ002
IC601	5322 209 84355	OQ002

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
IC602	5322 209 84355	OQ002
IC1301	5322 209 84452	709HC
IC1801	5322 209 84899	LM723CH
IC2401	5322 209 84355	OQ002
IC2402	5322 209 84355	OQ002
IC2601	5322 209 84355	OQ002
IC2602	5322 209 84355	OQ002
IC2801	5322 209 84355	OQ002
IC2802	5322 209 84355	OQ002
MISCELLANEOUS		
L 401	5322 281 64154	COIL
L 1301	5322 150 14015	ROTARY COIL
L 1800	5322 281 64154	COIL
L 1803	5322 152 24027	CHOKE
L 1804	5322 158 10052	COIL
L 1806	5322 281 64154	COIL
L 1807	5322 158 10052	COIL
L 1808	5322 281 64154	COIL
L 1809	5322 158 10052	COIL
L 1811	5322 281 64154	COIL
L 1812	5322 158 10052	COIL
L 1813	5322 281 64154	COIL
L 1814	5322 158 10052	COIL
L 1816	5322 281 64154	COIL
L 1817	5322 158 10052	COIL
L 1818	5322 281 64154	COIL
L 1819	5322 158 10052	COIL
L 1821	5322 281 64154	COIL
LA1	5322 134 44123	LAMP
LA2	5322 134 44123	LAMP
RE101	5322 280 24076	RELAY COIL
RE102	5322 280 24076	RELAY COIL
RE103	5322 280 24076	RELAY COIL
RE104	5322 280 24076	RELAY COIL
RE106	5322 280 24076	RELAY COIL
RE107	5322 280 24076	RELAY COIL
RE108	5322 280 24076	RELAY COIL
RE109	5322 280 24076	RELAY COIL
RE111	5322 280 24076	RELAY COIL
RE112	5322 280 24076	RELAY COIL
T 1401	5322 148 84023	TRANSFORMER
T 1801	5322 146 14069	TRAFO EXC
T 1802	5322 148 84026	TRAFO
VL1	4822 253 30024	FUSE
SK4	5322 105 34038	SWITCH
SK6	5322 105 34039	SWITCH
SK8	5322 276 14158	PUSH-BUTTON
SK10	5322 276 14158	PUSH-BUTTON
SK11	5322 276 14158	PUSH-BUTTON
SK13	5322 273 44043	SWITCH
SK22	5322 276 14158	PUSH-BUTTON

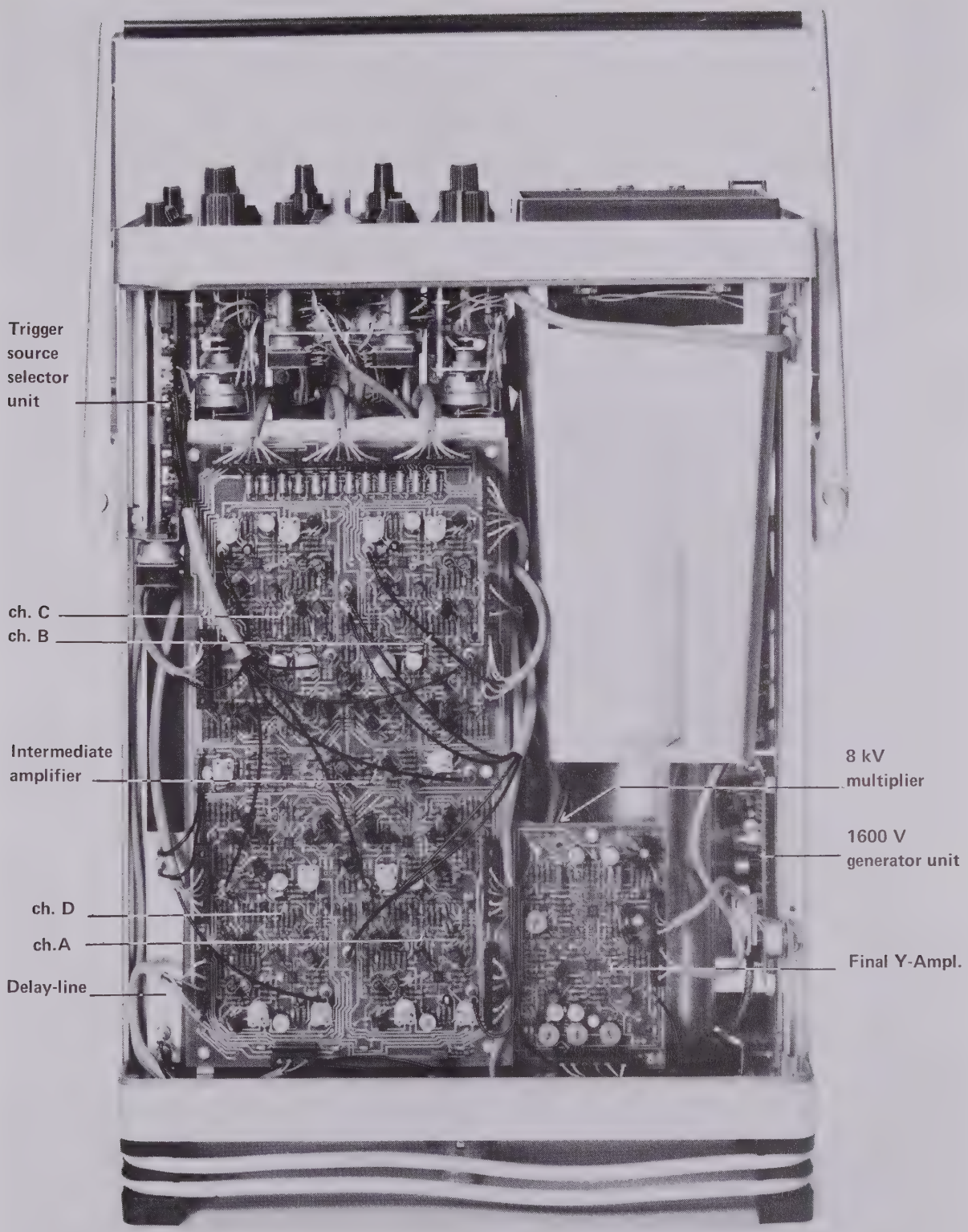


Fig. 3.1. Unit location, top view

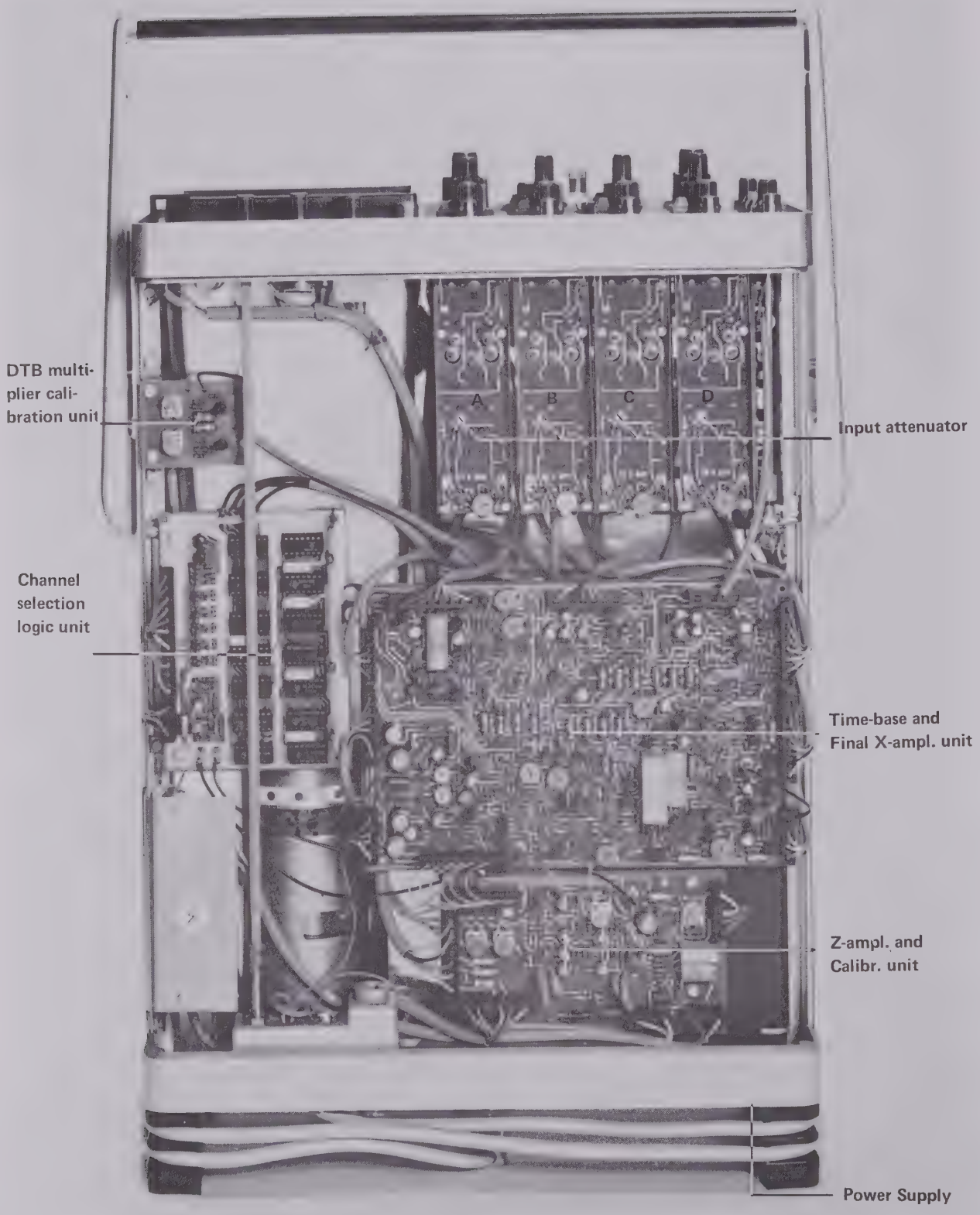


Fig. 3.2. Unit location, bottom view

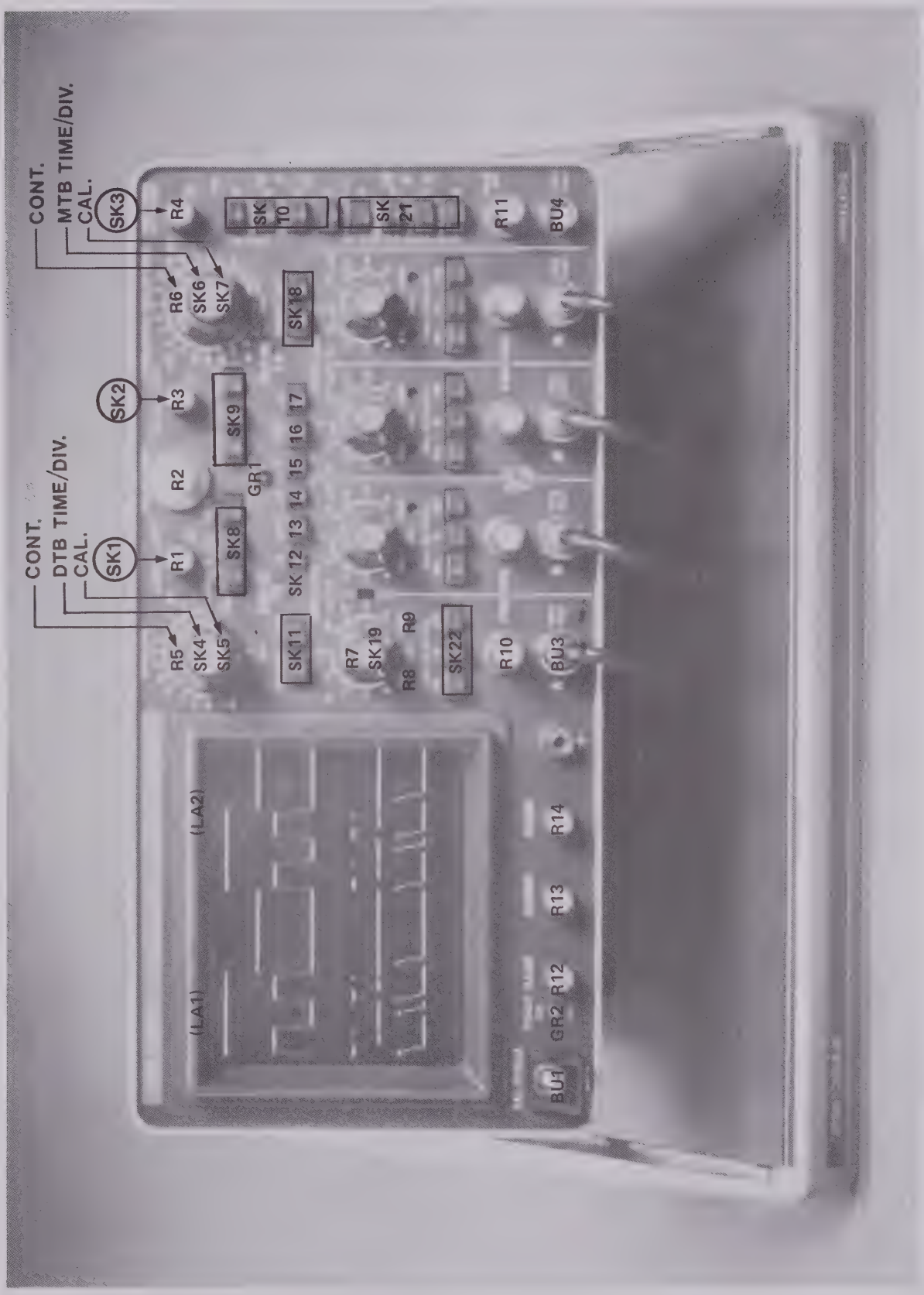


Fig. 3.3. Electrical item numbers, front panel

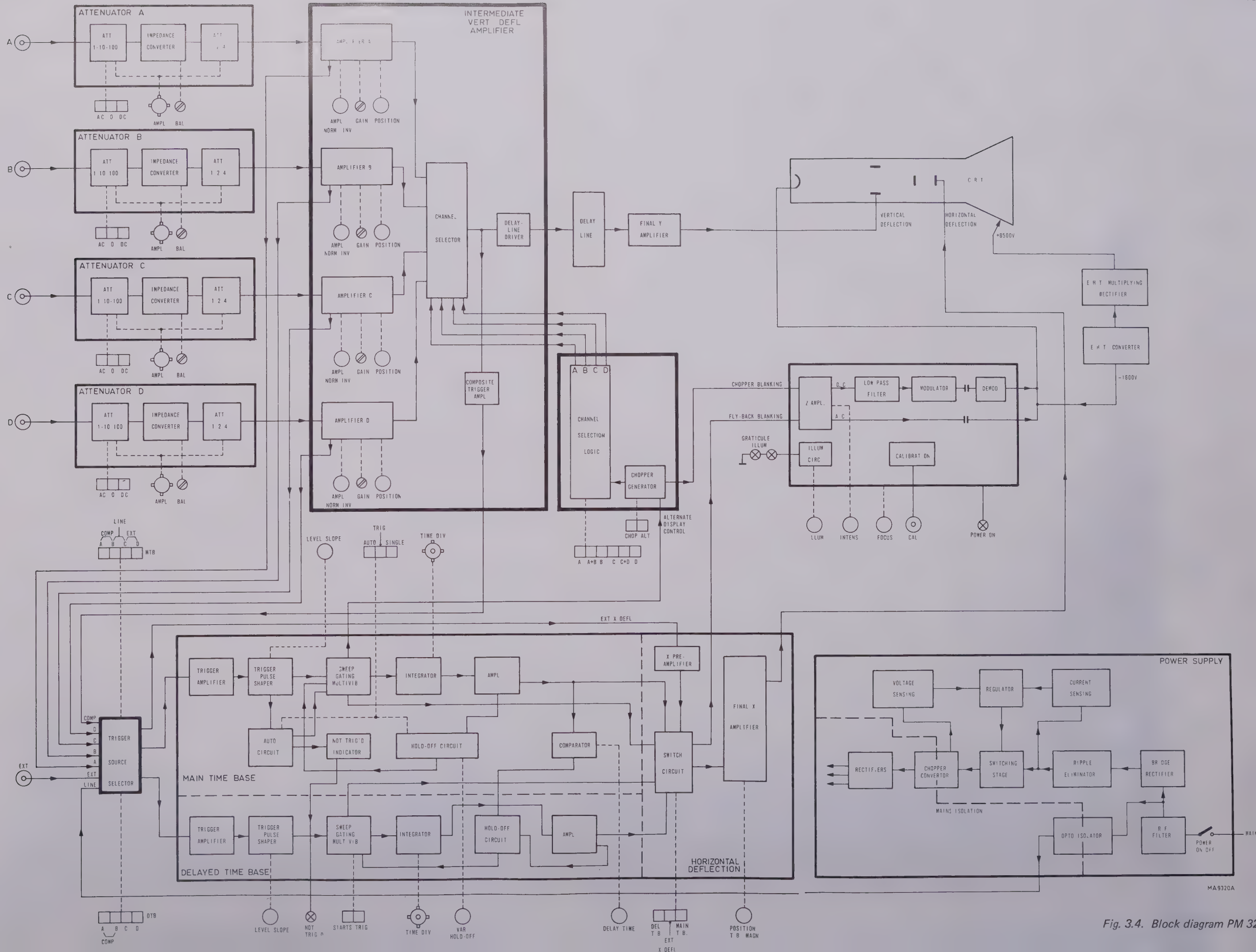


Fig. 3.4. Block diagram PM 3244

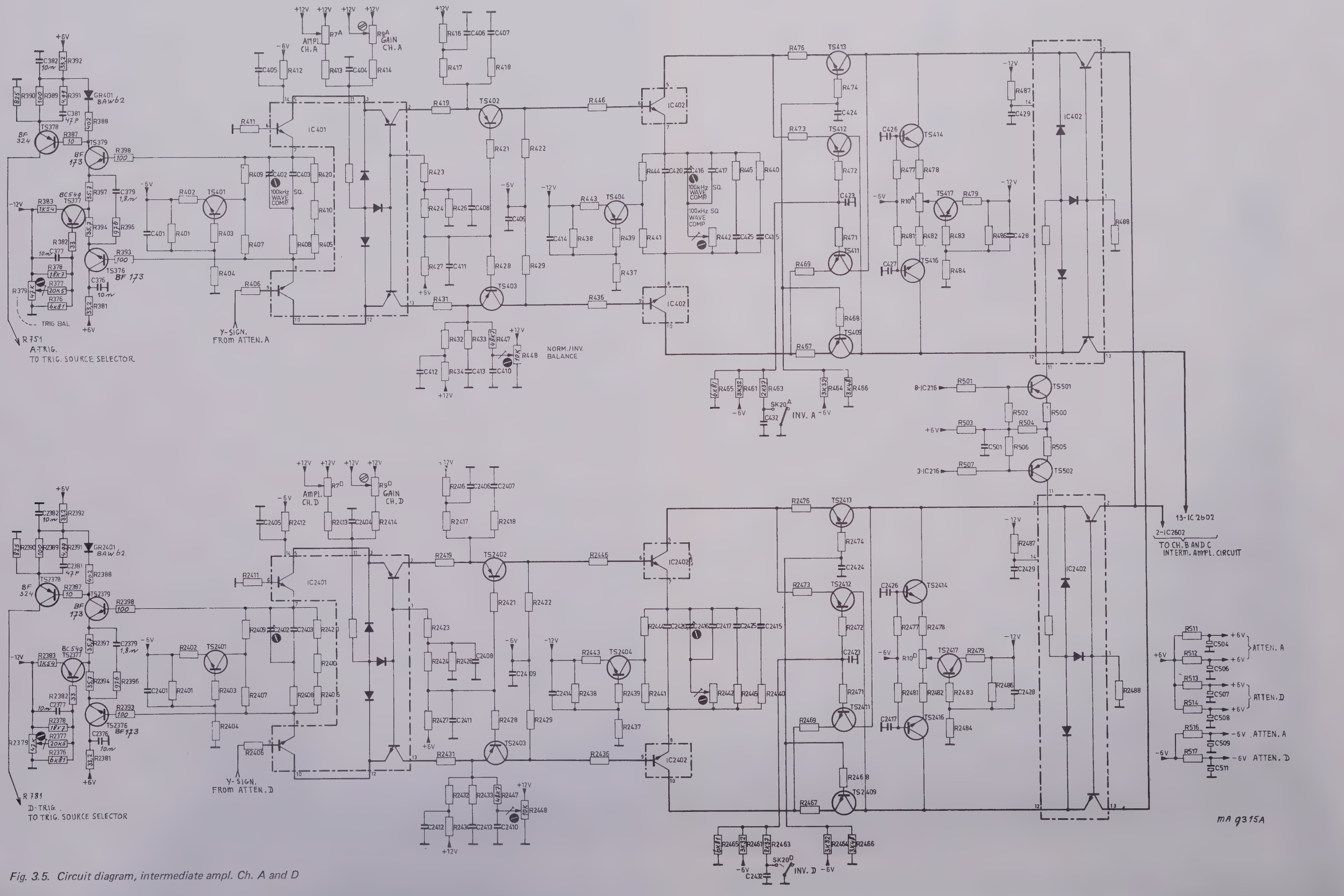
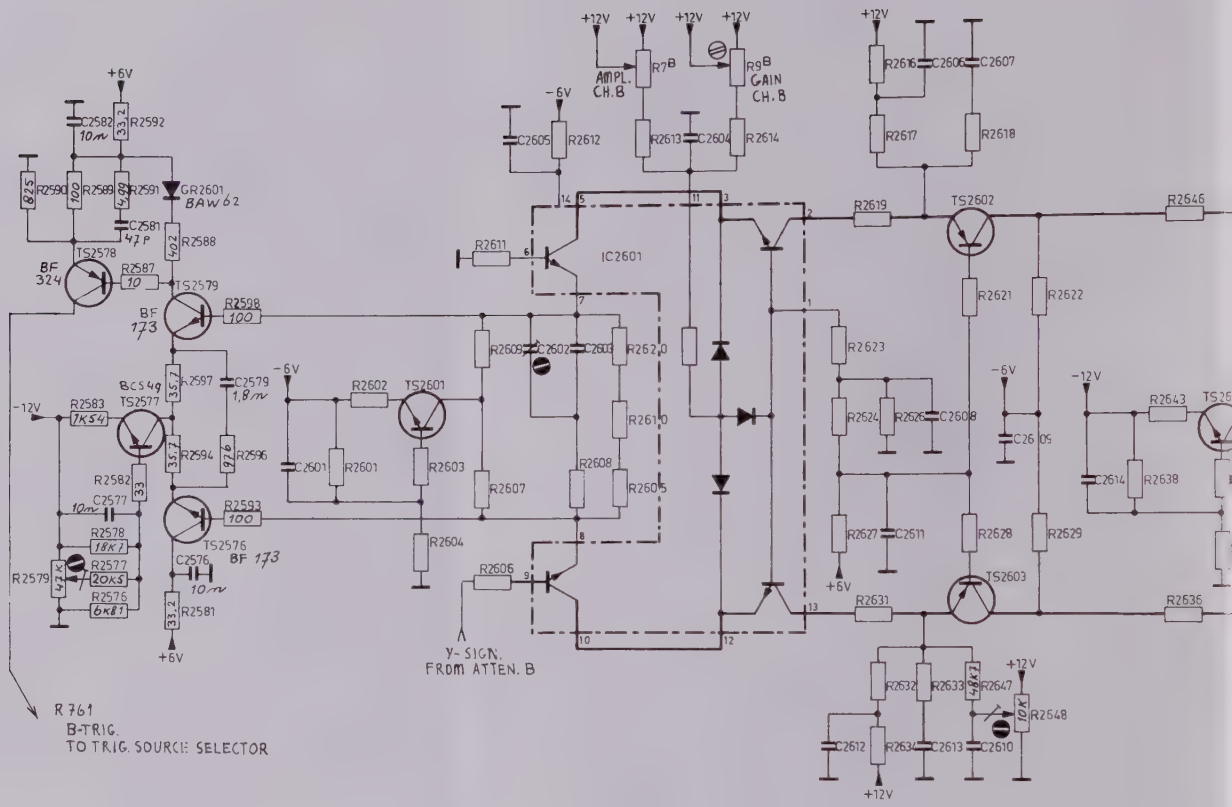
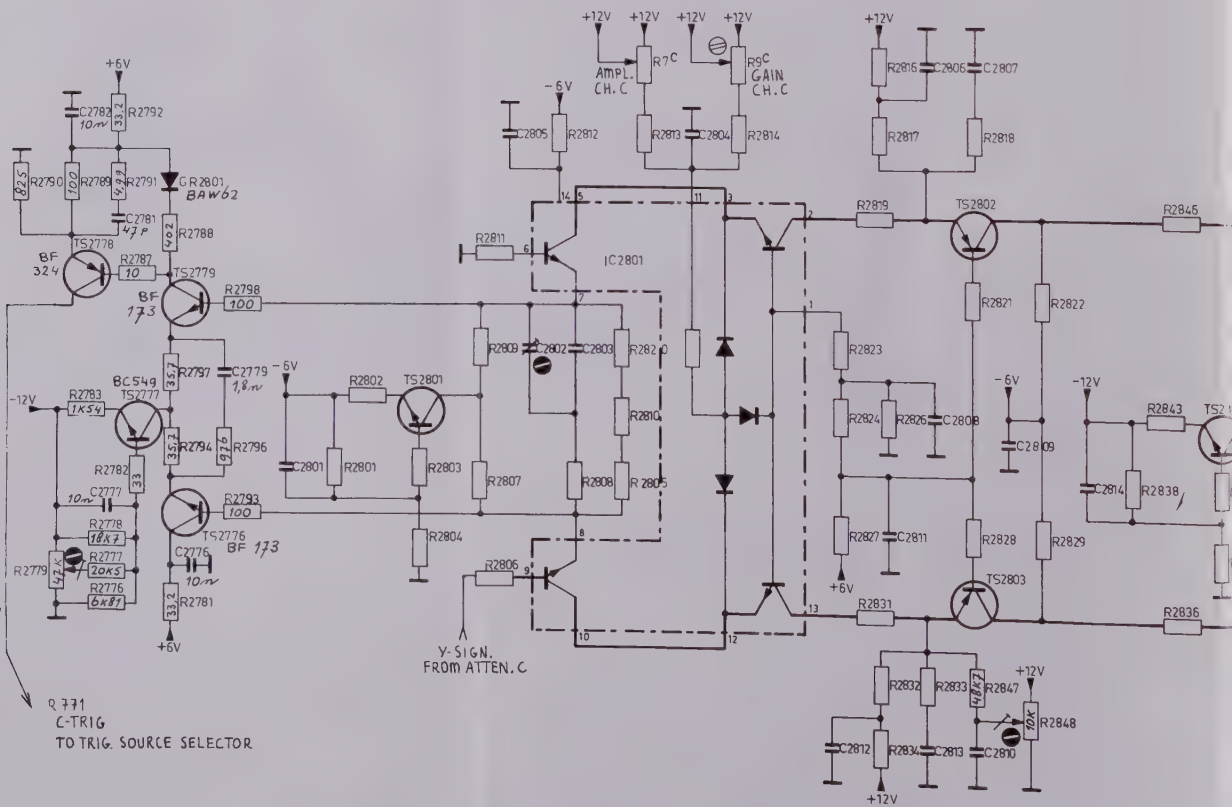


Fig. 3.5. Circuit diagram, intermediate ampl. Ch. A and D


+12V
AMPL. CH.B
R7B
R9B GAIN CH.B
IC2601
TS2602
TS2603
TS2601
TS2577
TS2578
TS2579
TS2576
GR2601 BAW62
BF 324
BF 173
BC549
Y-SIGN. FROM ATTEN. B
R761 B-TRIG. TO TRIG. SOURCE SELECTOR


+12V
AMPL. CH.C
R7C
R9C GAIN CH.C
IC2801
TS2802
TS2803
TS2801
TS2777
TS2778
TS2779
TS2776
GR2801 BAW62
BF 324
BF 173
BC549
Y-SIGN. FROM ATTEN. C
R771 C-TRIG TO TRIG. SOURCE SELECTOR

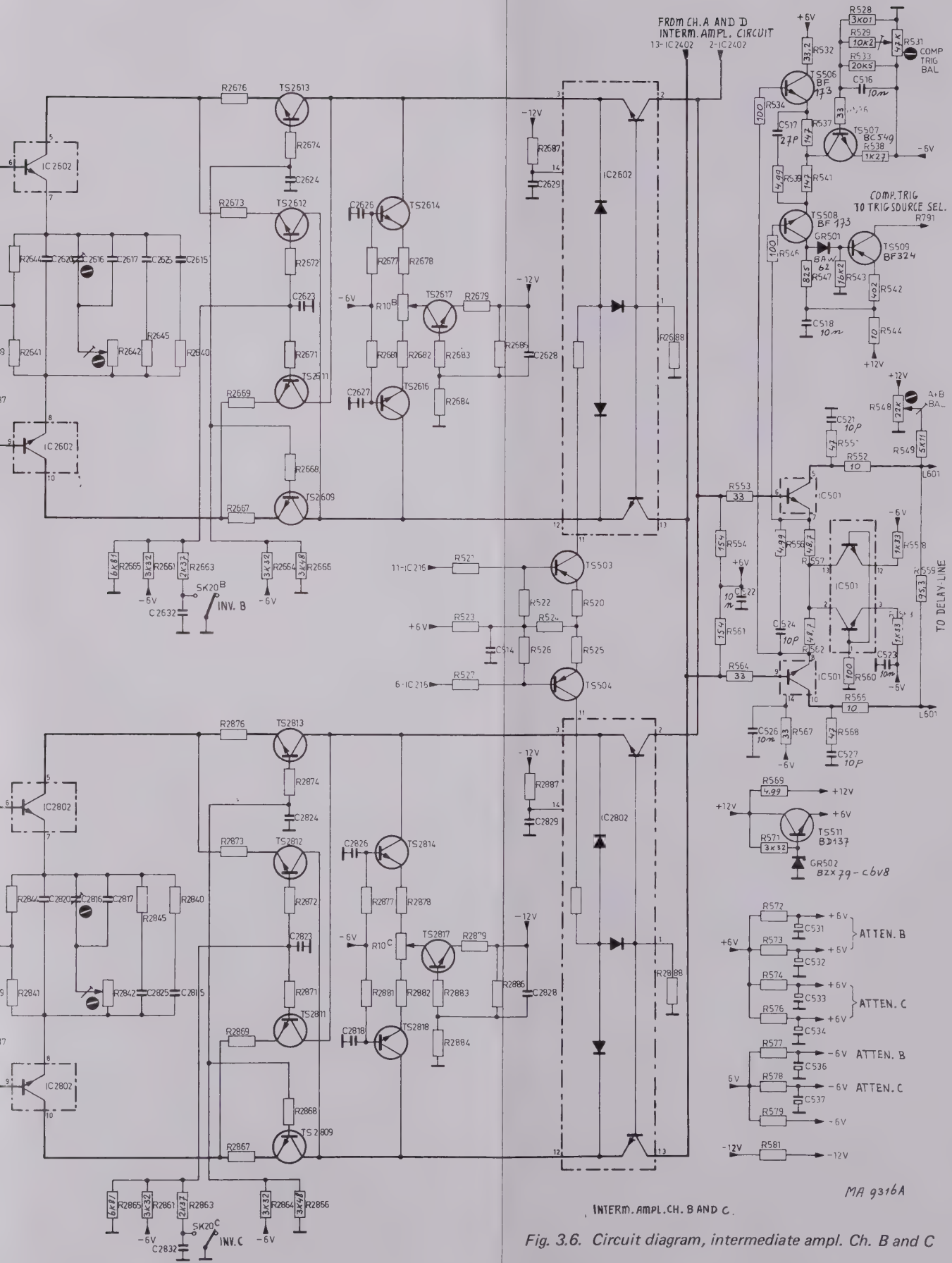


Fig. 3.6. Circuit diagram, intermediate ampl. Ch. B and C

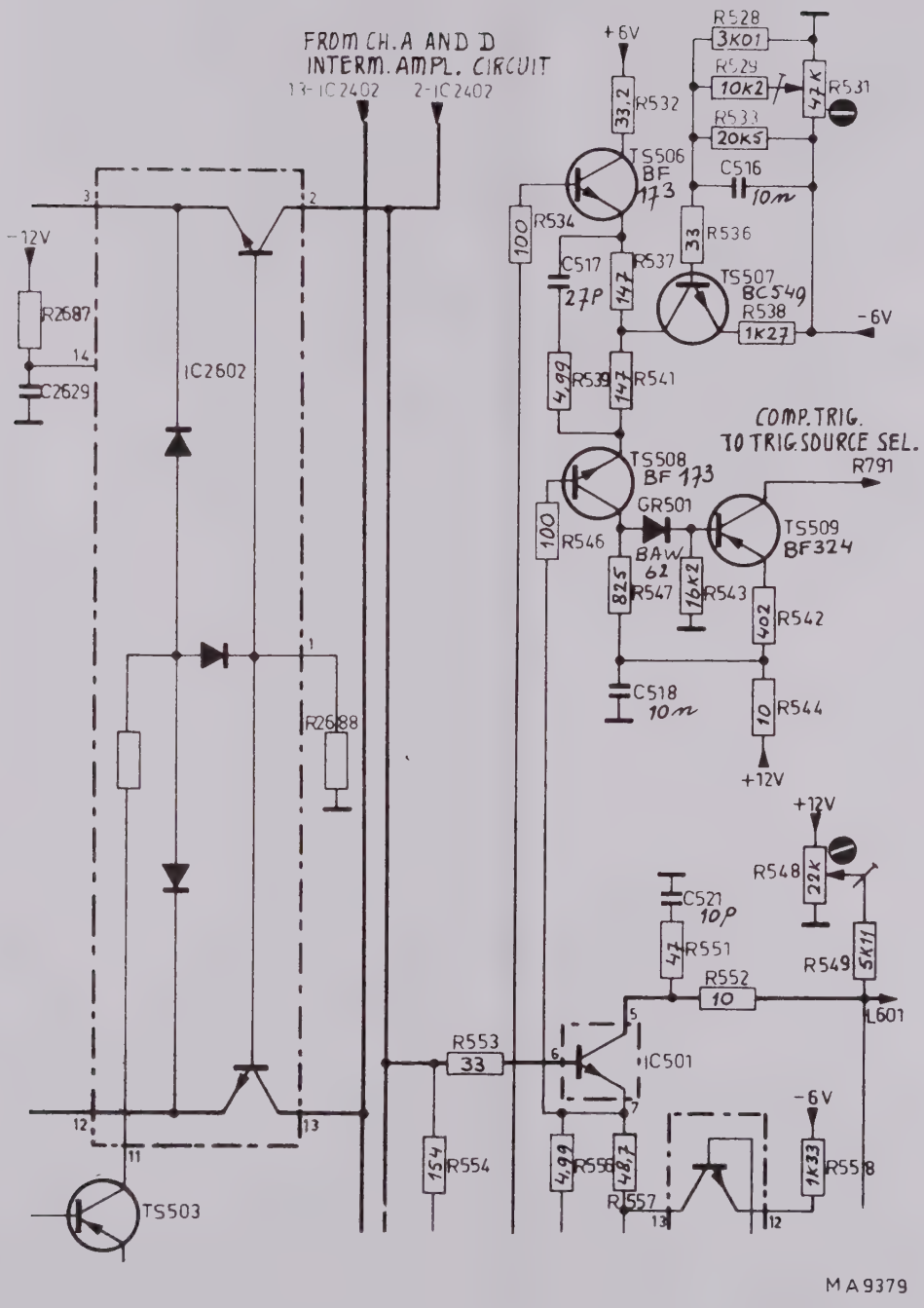


Fig. 3.7. Basic circuit for composite triggering

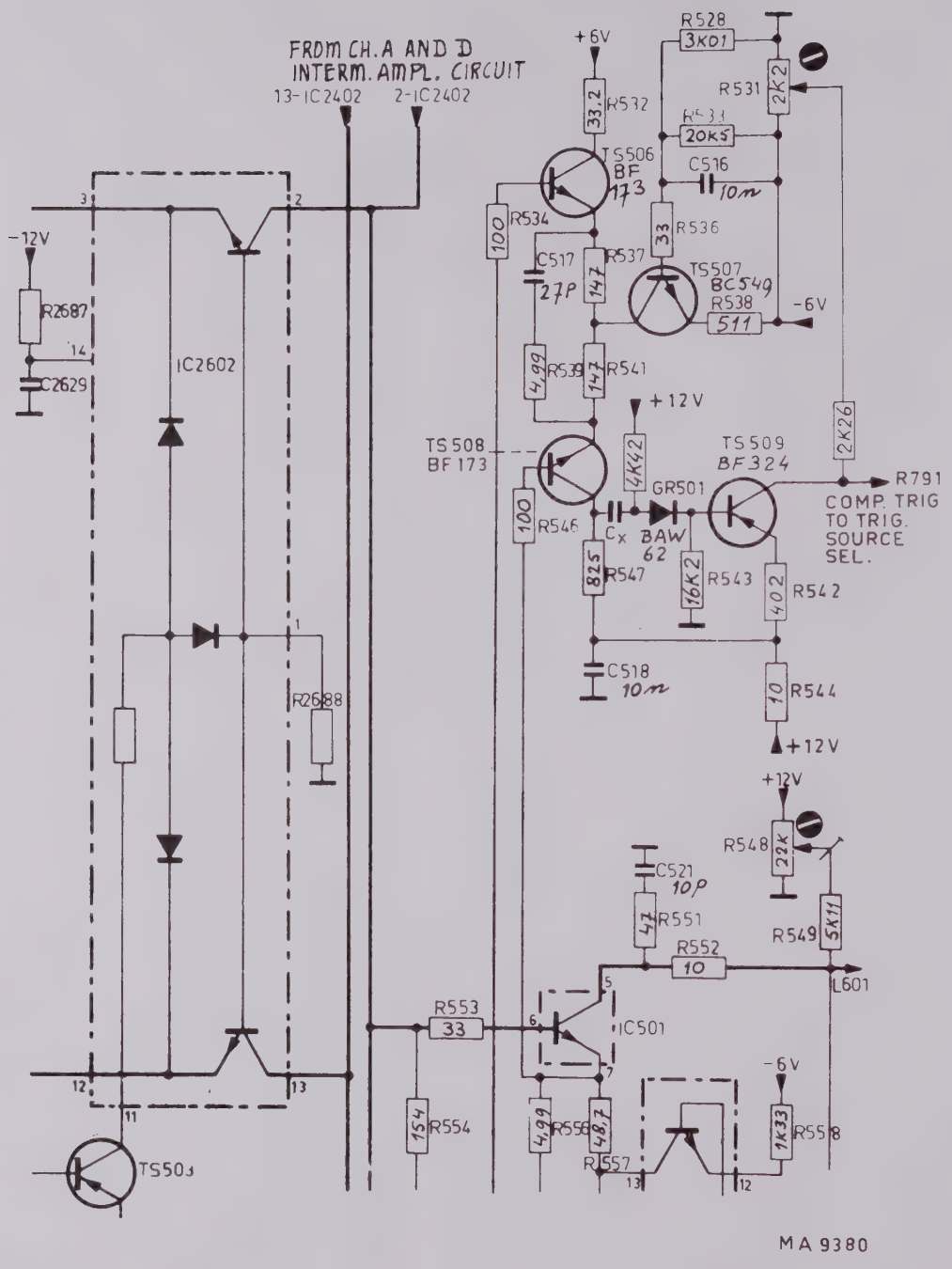


Fig. 3.8. Modified circuit for A.C. composite triggering

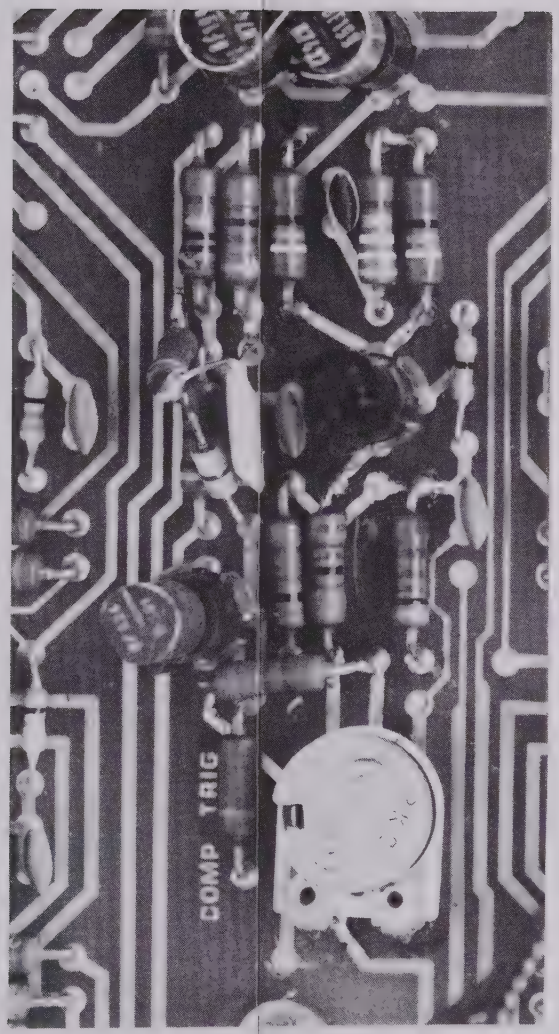
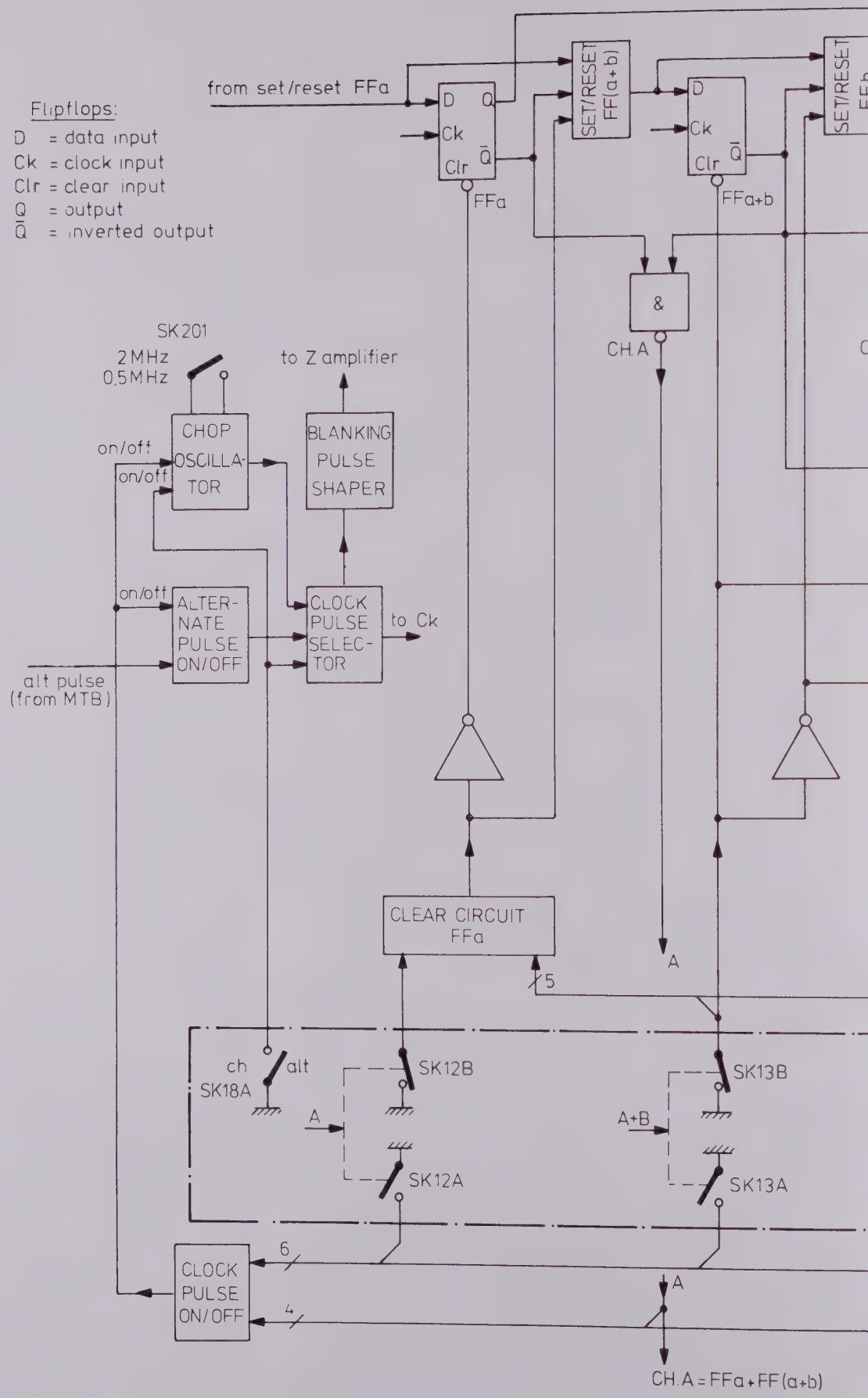


Fig. 3.9. Modified circuit lay out for A.C. composite triggering


Flipflops:
D = data input
Ck = clock input
Clr = clear input
Q = output
Q̄ = inverted output
from set/reset FFa
D
Ck
Clr
Q
Q̄
FFa
SET/RESET FF(a+b)
FFa+b
&
CH.A
SK201
2 MHz
0,5 MHz
to Z amplifier
CHOP OSCILLATOR
BLANKING PULSE SHAPER
on/off
ALTERNATE PULSE ON/OFF
CLOCK PULSE SELECTOR
to Ck
alt pulse (from MTB)
CLEAR CIRCUIT FFa
5
A
ch
alt
SK18A
SK12B
SK13B
A
A+B
SK12A
SK13A
6
4
CLOCK PULSE ON/OFF
CH.A = FFa + FF(a+b)

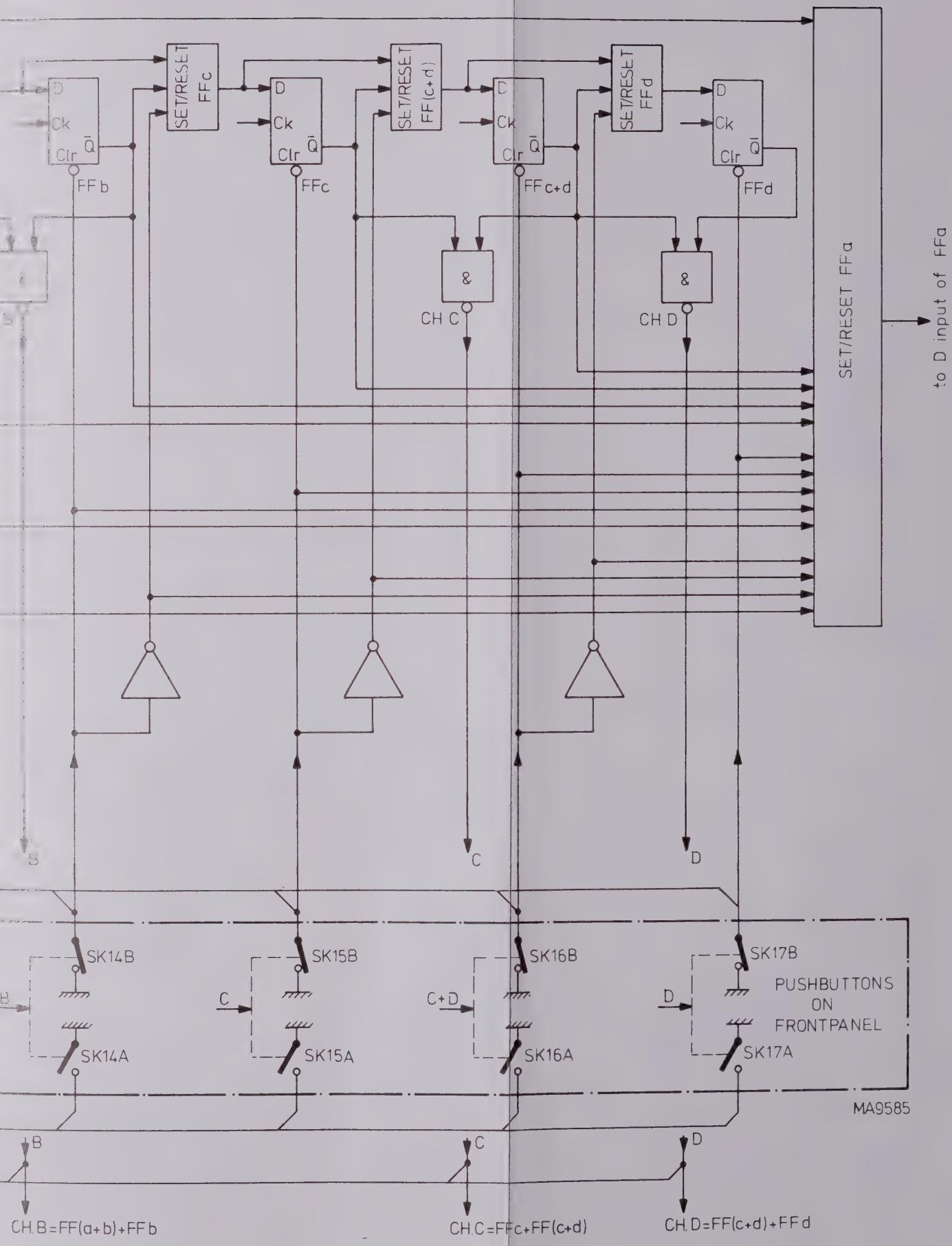
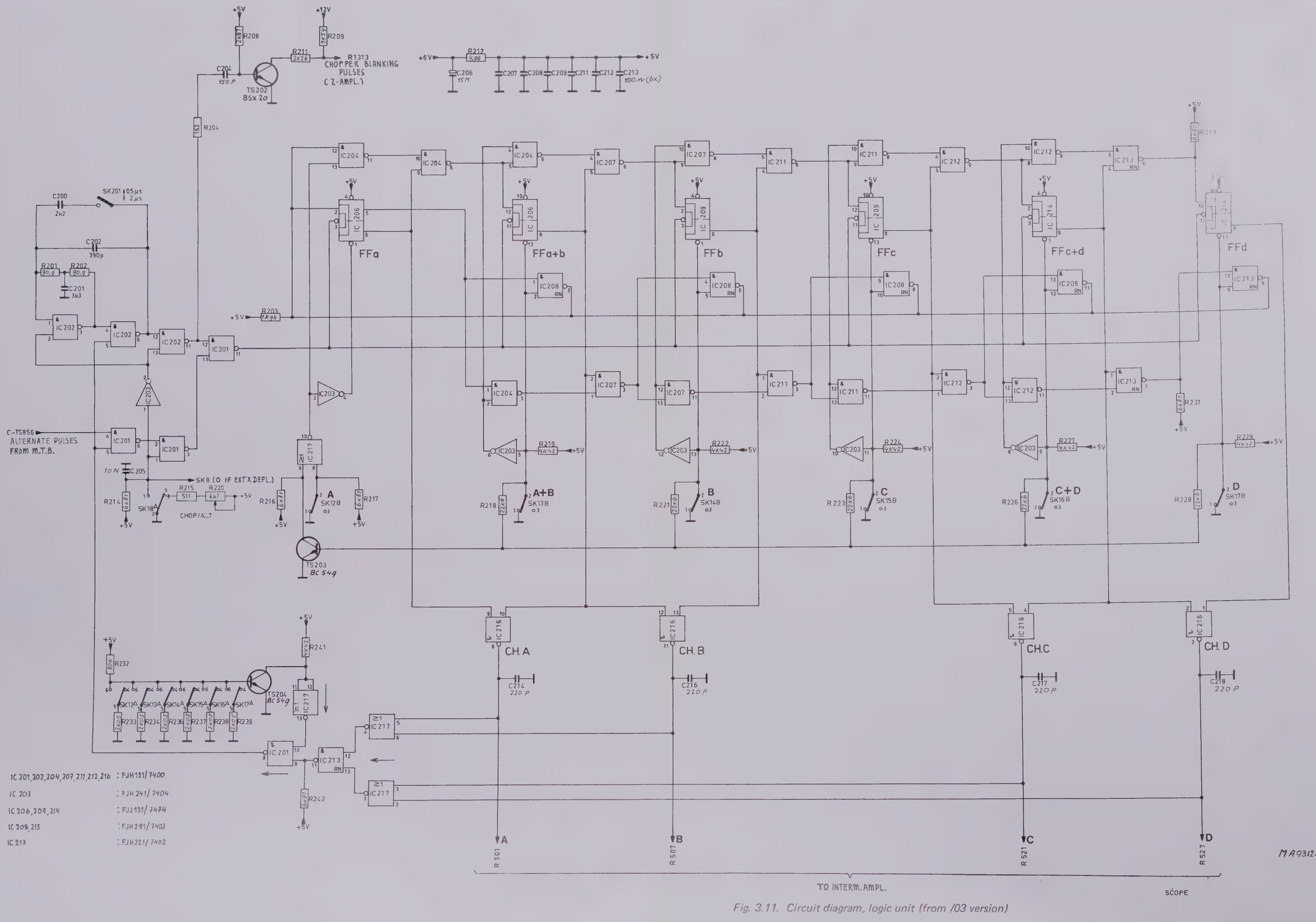


Fig. 3.10. Block diagram channel selection logic



IC 201,202,204,207,211,212,216 : FJH131/7400
IC 203 : FJH241/7404
IC 206,209,214 : FJJ131/7474
IC 208,213 : FJH291/7403
IC 217 : FJH221/7402

Fig. 3.11. Circuit diagram, logic unit (from /03 version)

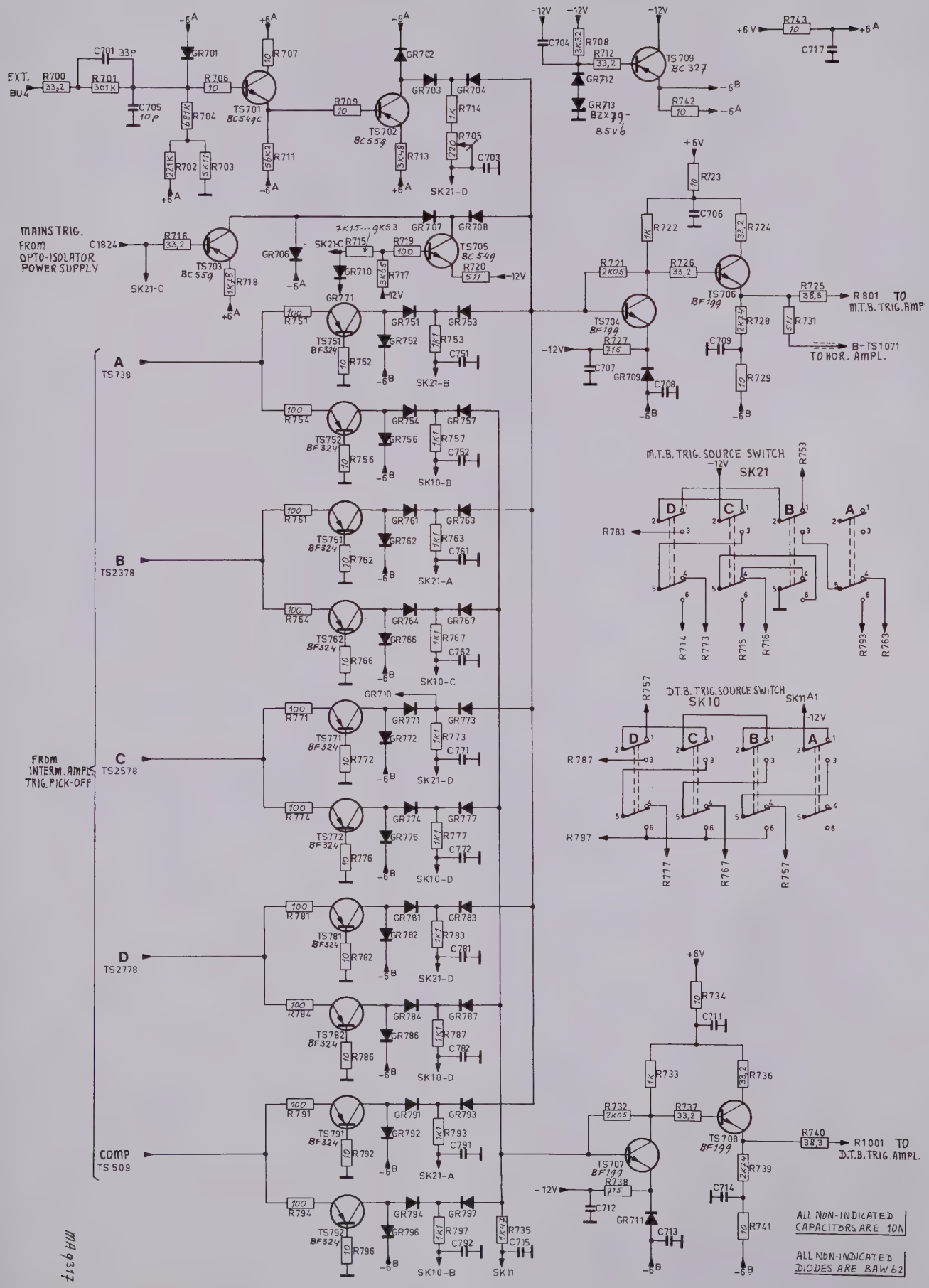


Fig. 3.12. Circuit diagram, trigger source selector

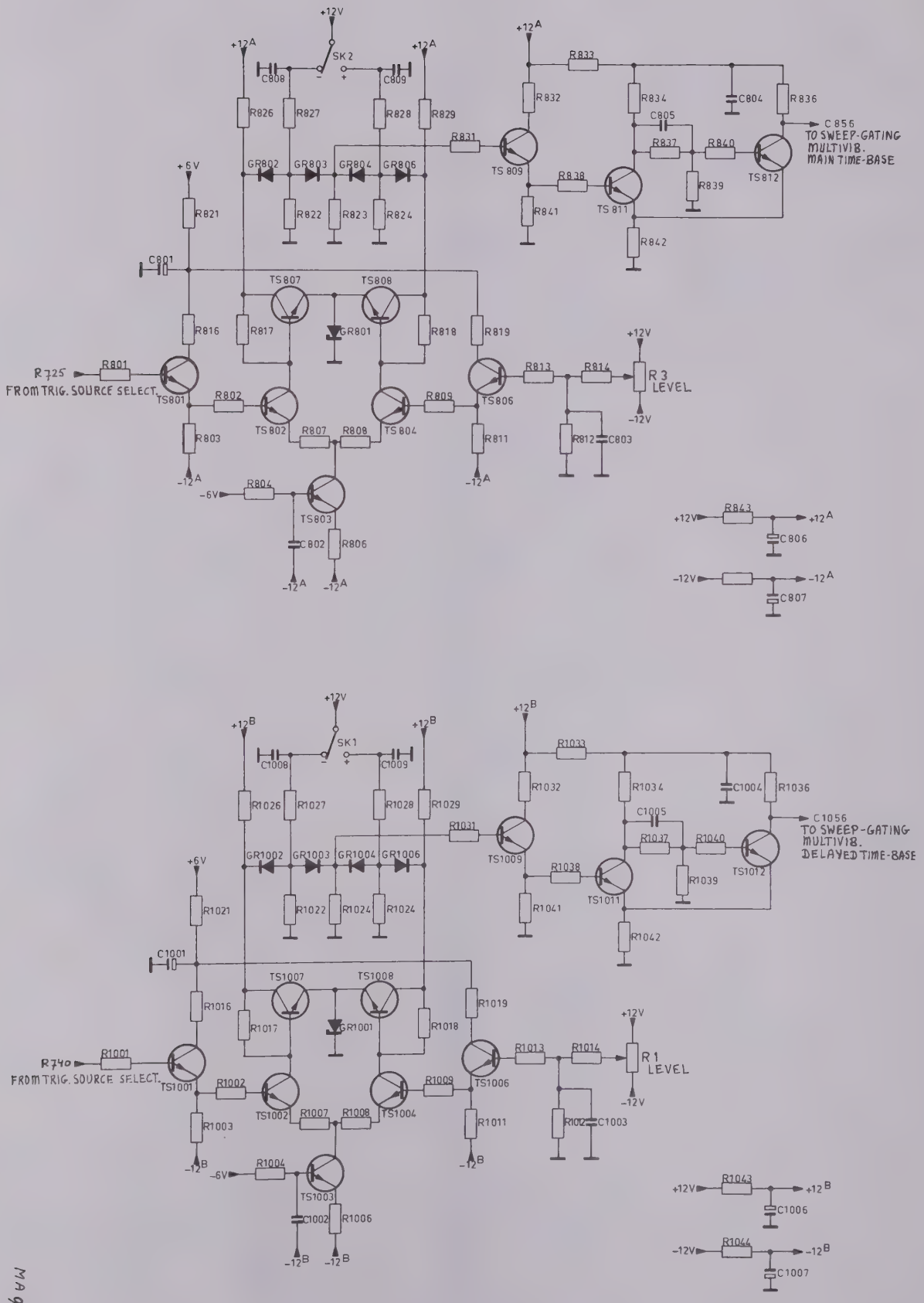


Fig. 3.13. Circuit diagram, trigger amplifier

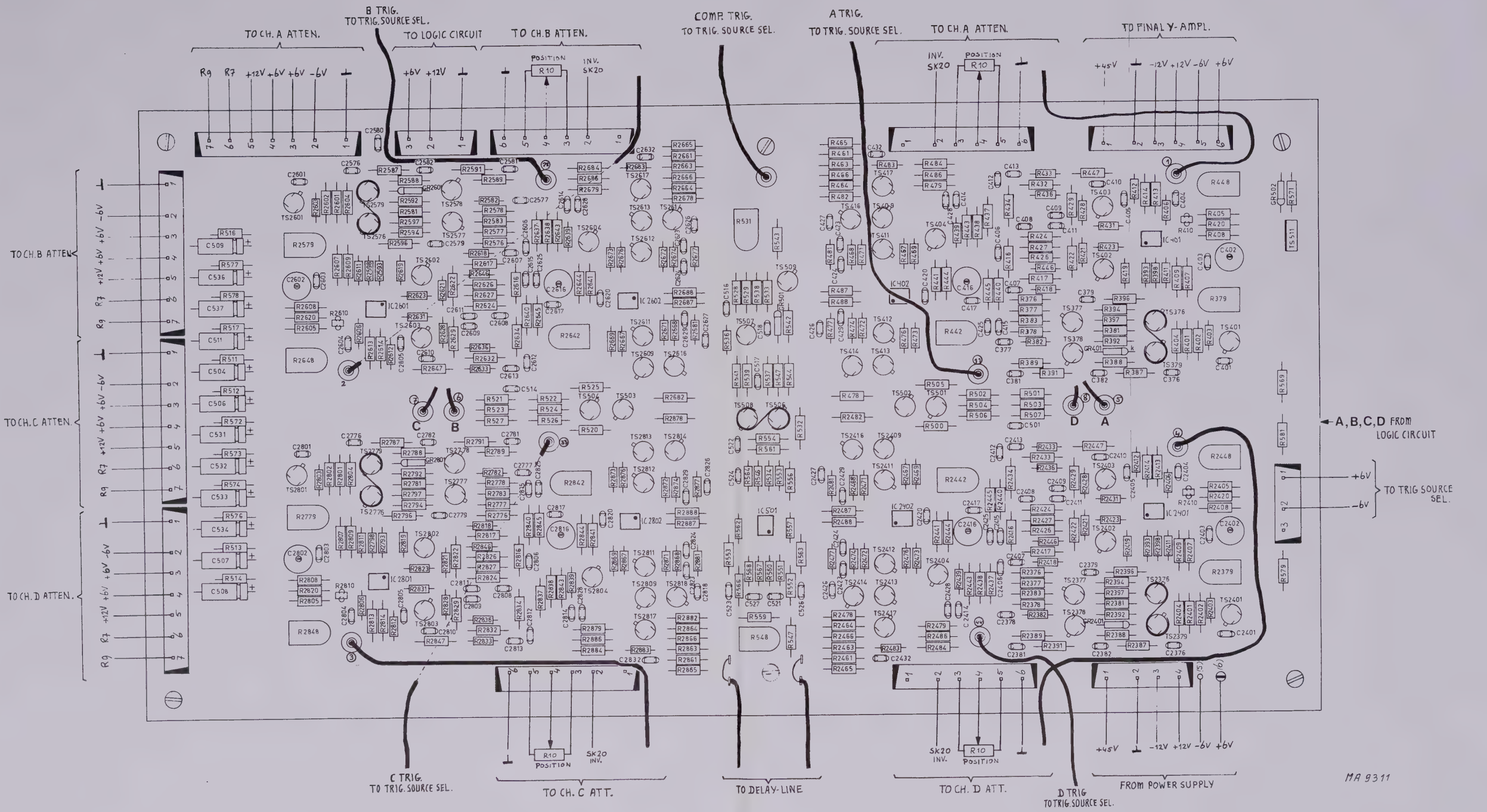


Fig. 3.14. Components lay-out, intermediate amplifier

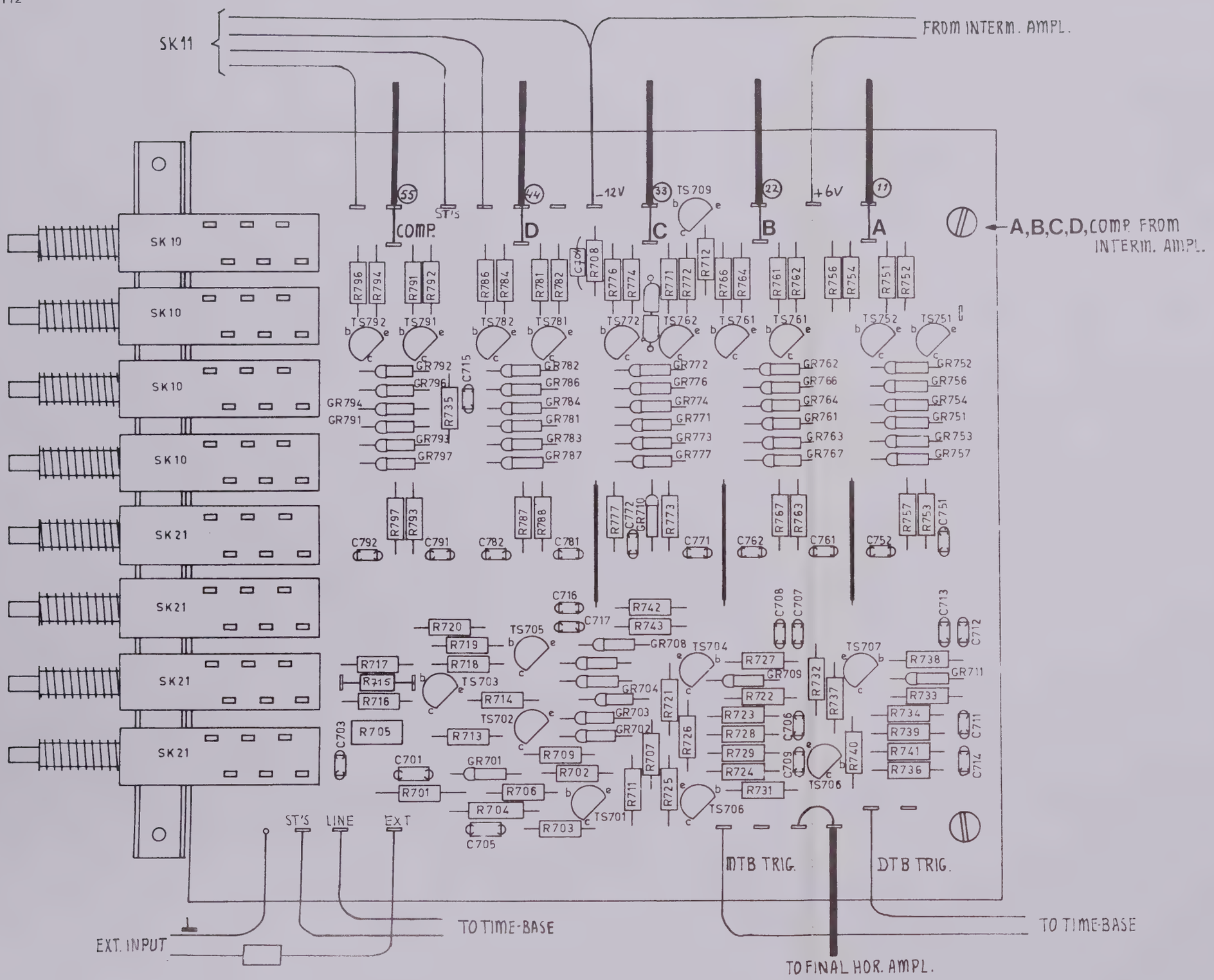


Fig. 3.15. Components lay-out, trigger source selector

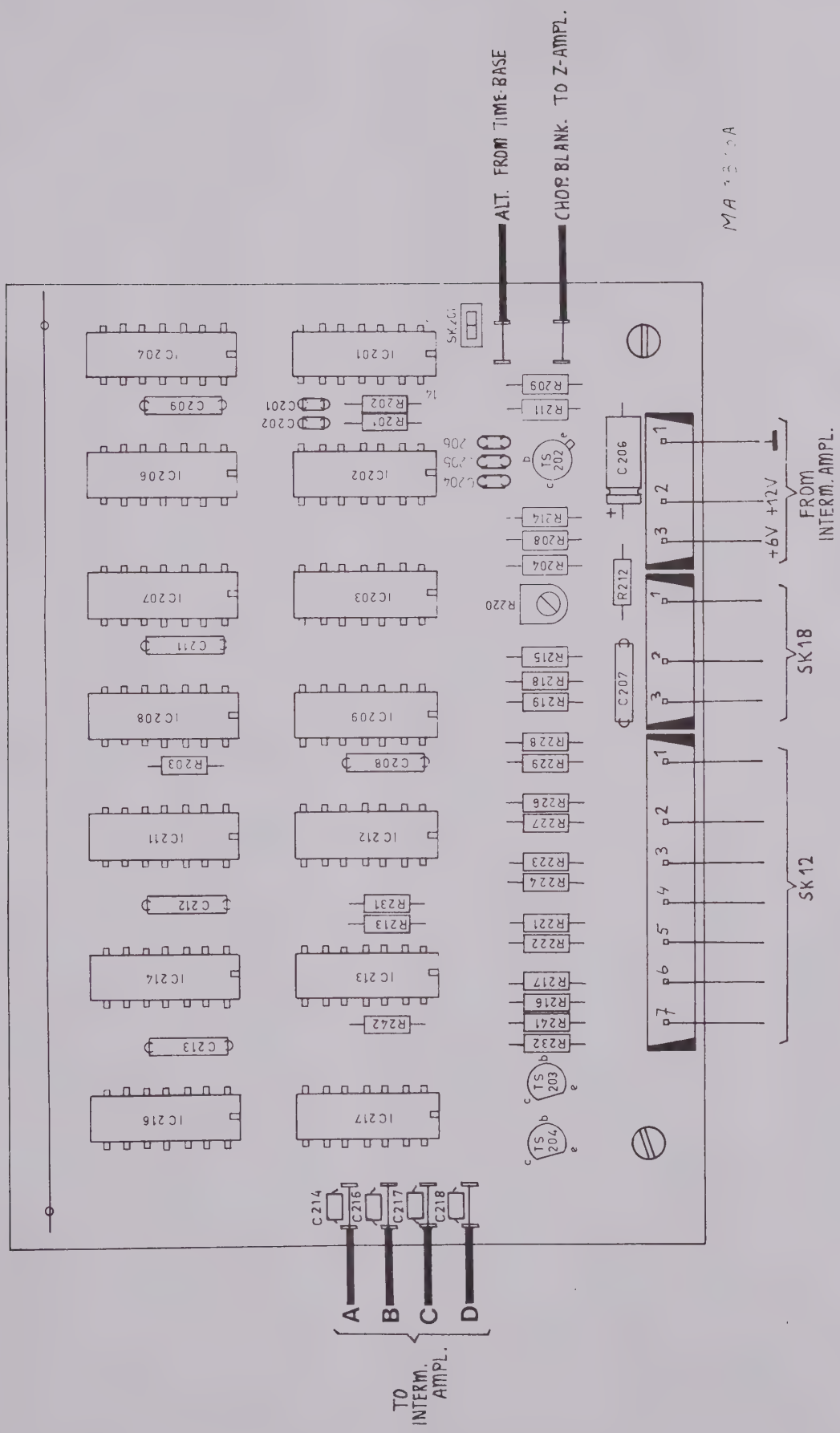


Fig. 3.16. Components lay-out, logic unit (from /03 version)

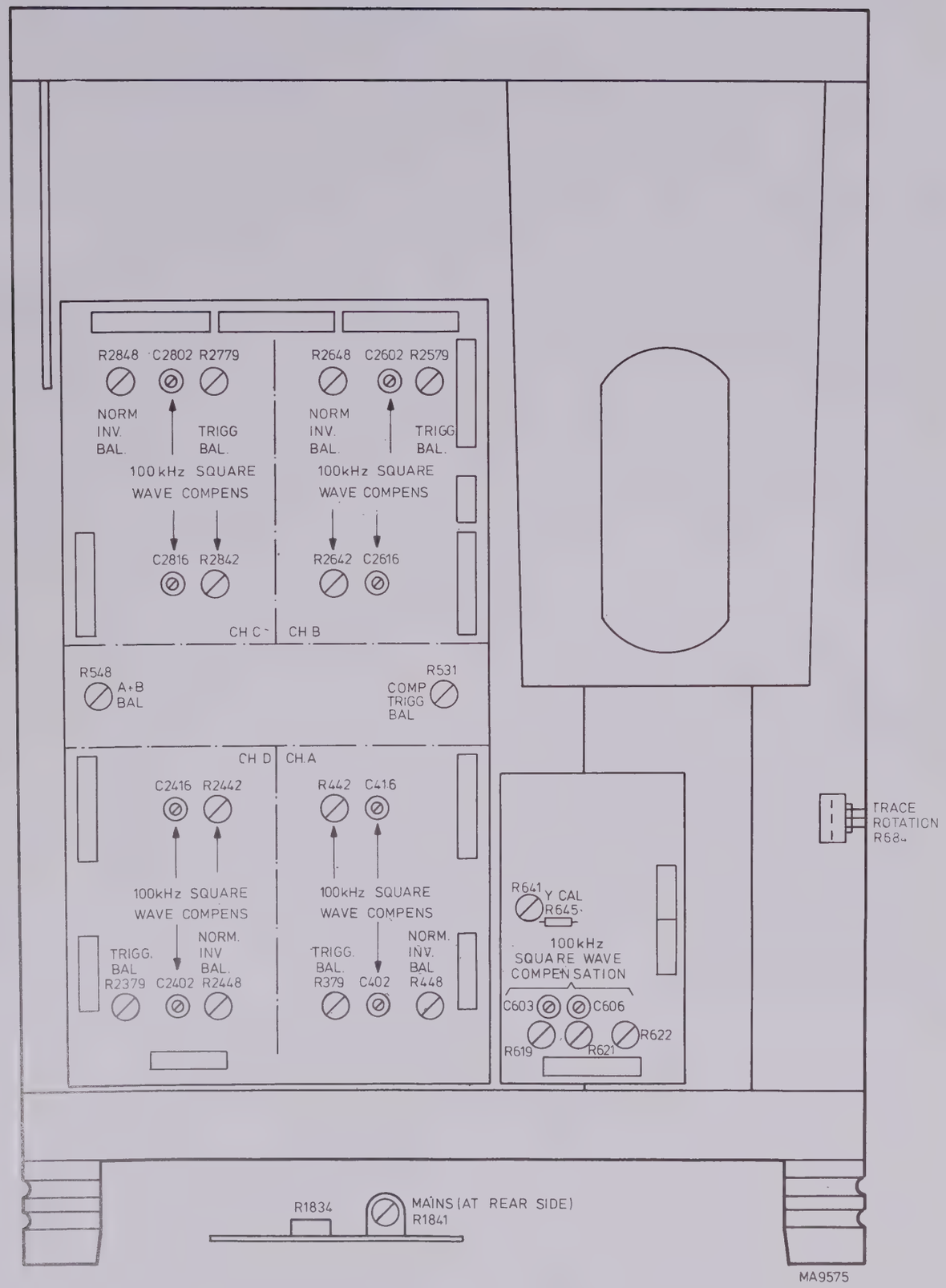


Fig. 3.17. Adjustment points, top view

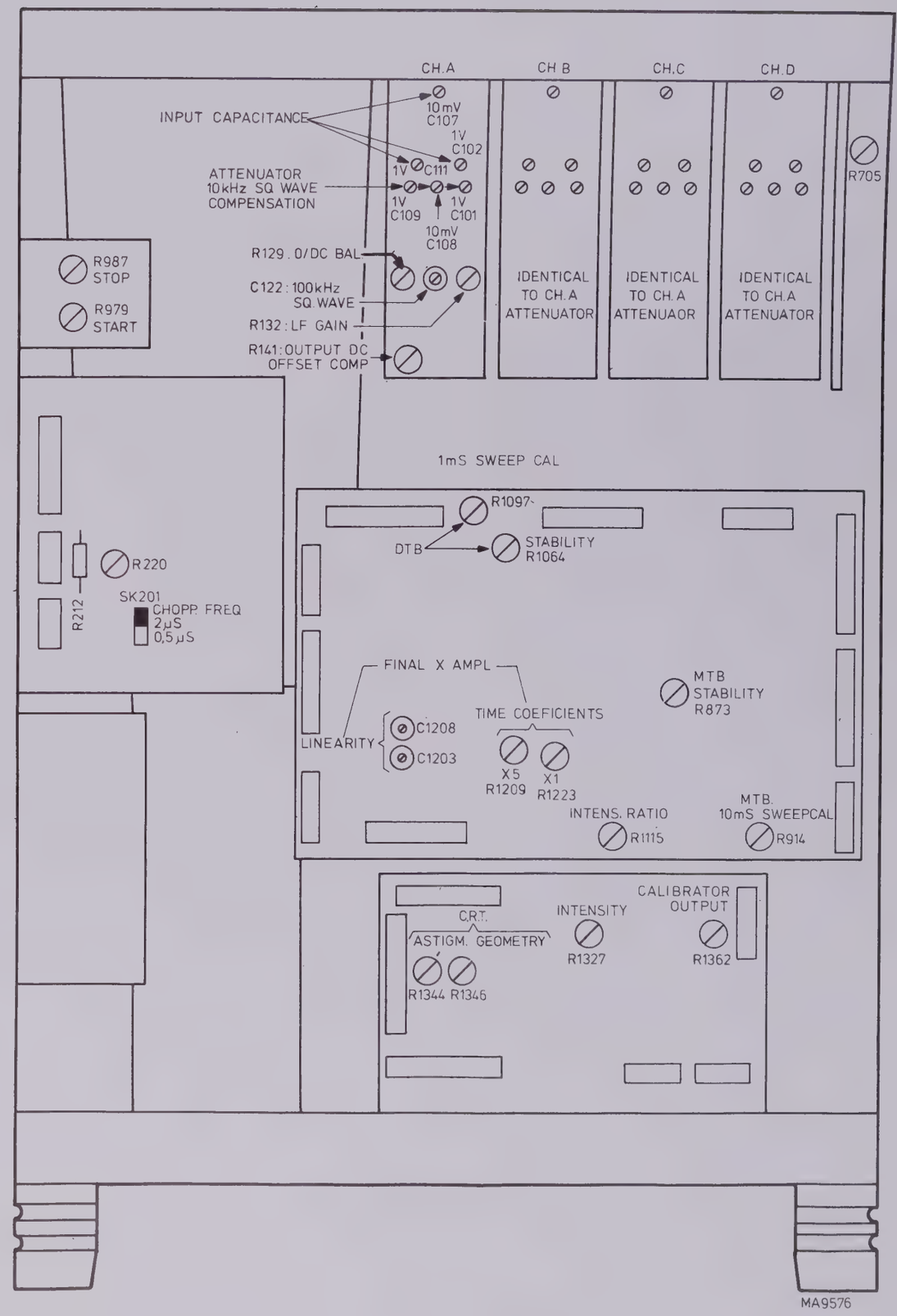


Fig. 3.18. Adjustment points, bottom view

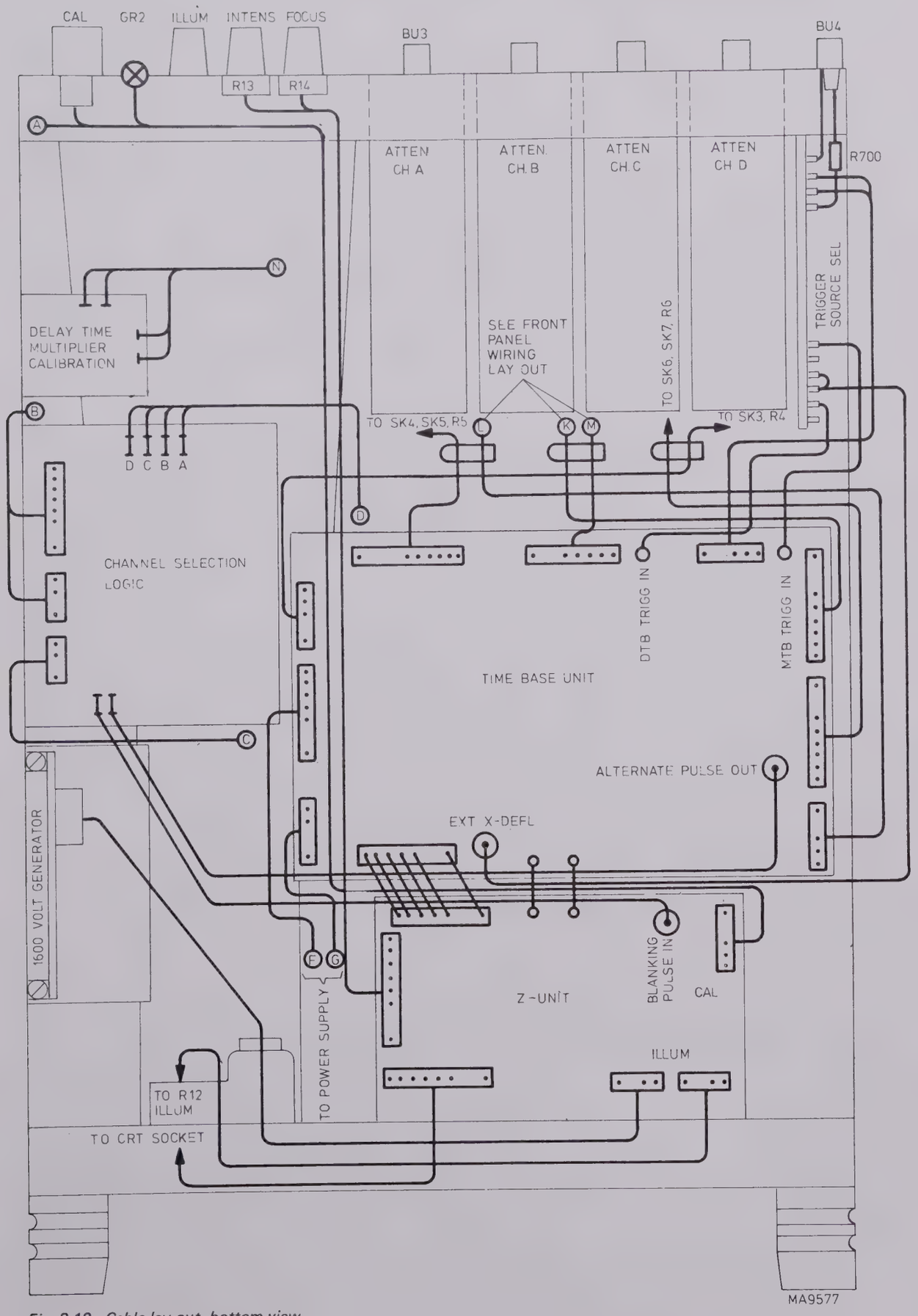


Fig. 3.19. Cable lay-out, bottom view

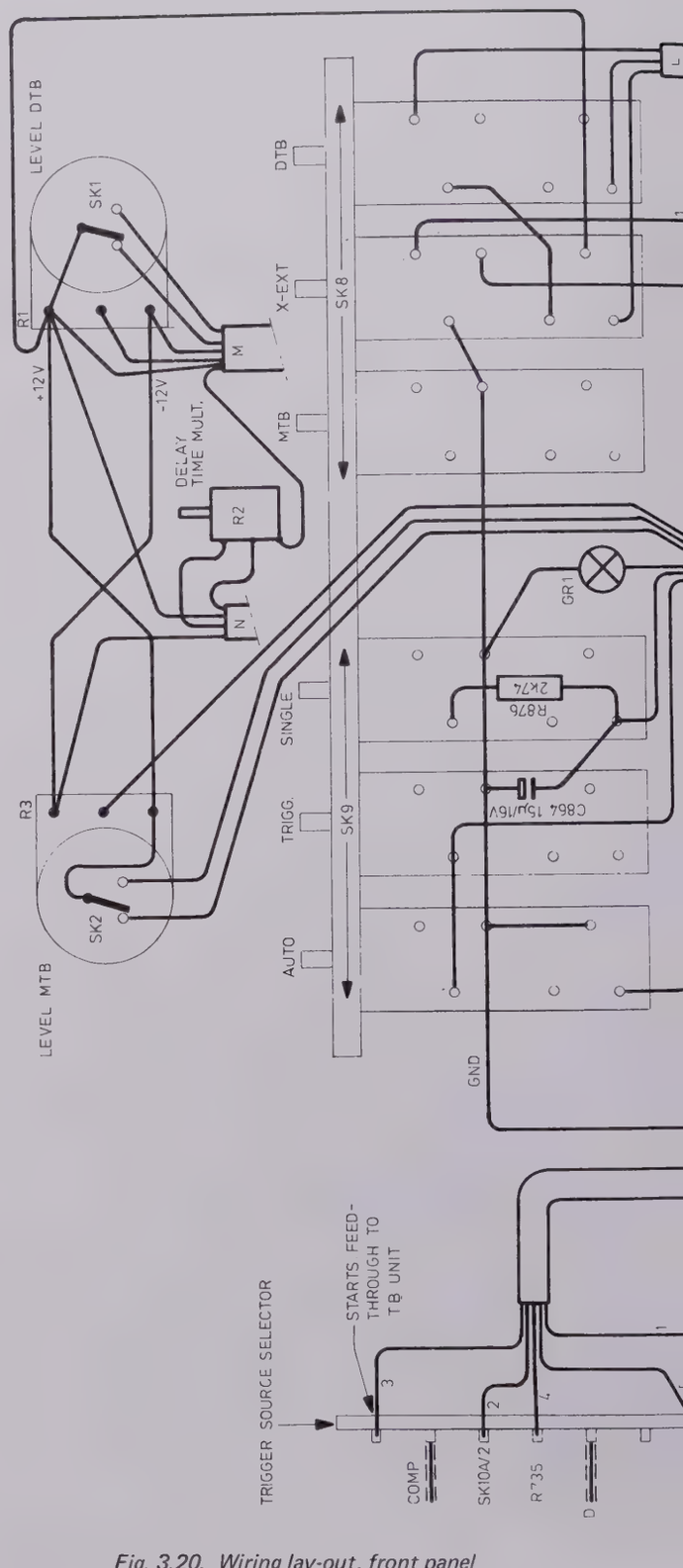


Fig. 3.20. Wiring lay-out, front panel

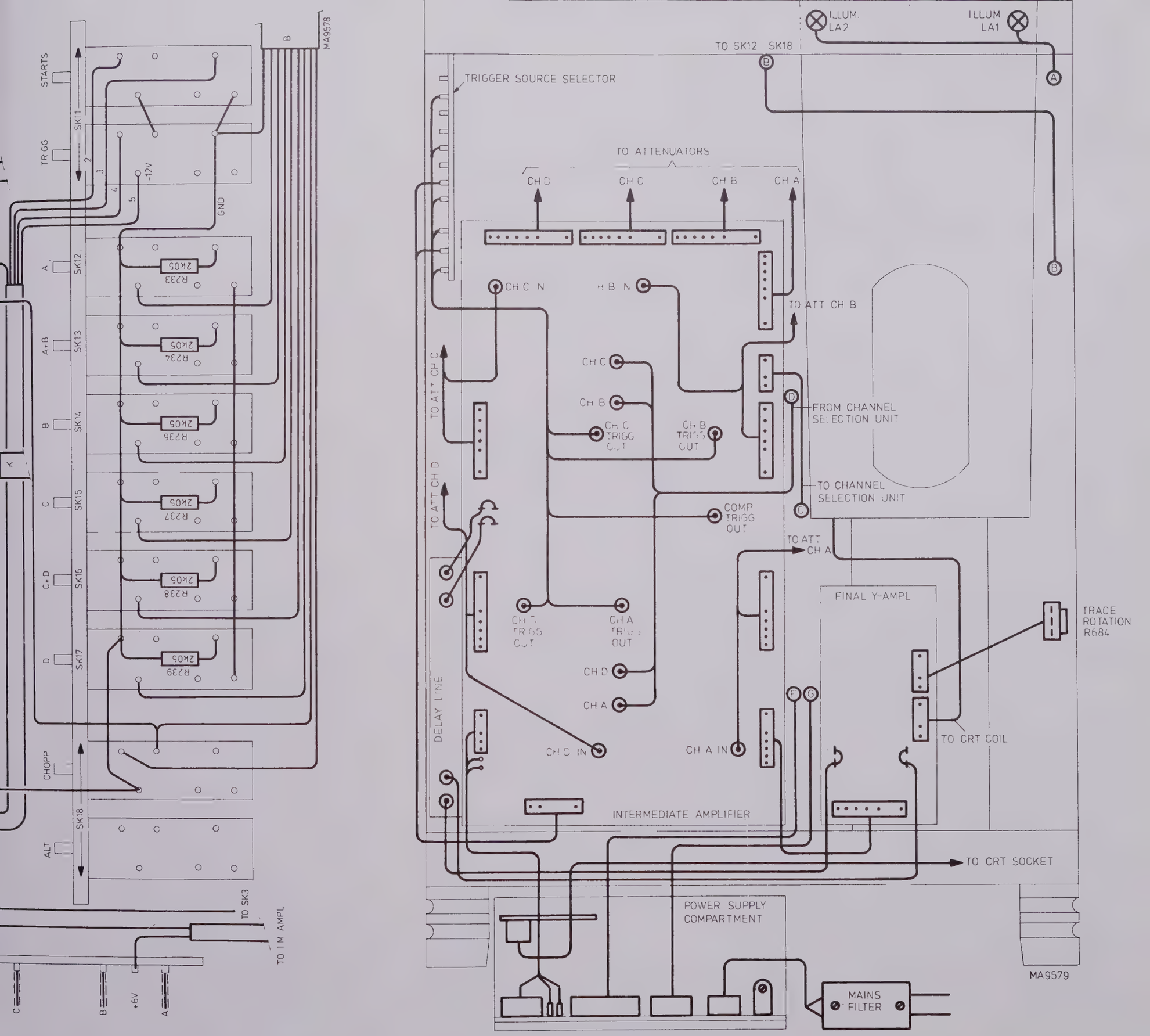


Fig. 3.21. Cable lay-out, top view and power supply compartment

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
32	150475	OPM 3260 02	DO 0078 3

CODED FAILURE DESCRIPTION ⑥

⑤ Nature of call	Location	Component/sequence no.	Category
☐ Installation		TS 0607	5
☐ Pre sale repair		R 0063 1	2
☐ Preventive maintenance	0021	99 0001	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ ☐☐12 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 32 = Switzerland

②Day Month Year 150475 = 15 April 1975

③Type number/Version OPM 3260 02 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number DO 0078 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

☐☐12 = 1,2 working hours (1 h 12 min.)

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